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A Multi-Scale Study of Stakeholder Participation and Visualisation in Chinese Urban Planning: The Case of the Pearl River Delta

by

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Abstract

It is widely assumed that stakeholder participation in China differs from that elsewhere due to China's unique historical, political and cultural context. Yet, hardly any systematic studies exist focusing on this topic. Generally, visualisation can provide bridges to connect stakeholders with diverse backgrounds. Studies of visualisation media in participatory planning have mainly focused on the local scale; what is missing is a multi-scalar approach into their usages in planning processes. This thesis aims to take a multi-scale perspective on stakeholder participation and visualisation in Chinese planning policies and practices. Grounded in theories of perception and stakeholder analysis, a mixed-method approach is employed, incorporating document analysis, interviews, ethnographic observations, questionnaires, and gaze-tracking techniques.

First, a framework analysis scrutinises stakeholder participation and visualisation media in the statutory Chinese urban planning system. Second, three case studies involving various planning scales and content are introduced: Urban Planning Exhibition Halls in the Pearl River Delta (provincial level); Pazhou Internet Innovation Cluster (subdistrict level); and the micro-renewal of Puntoon Wuyue Village (community level). Third, the effectiveness of and interrelationships between stakeholder participation and visualisation media are examined at different scales. Finally, a critical comparison of institutional regulations and local practices is presented.

The research promotes understanding of stakeholder participation and visualisation in Chinese urban planning processes. It examines the operation of newly emerging participatory mechanisms, such as chief urban designers and community planners, in local practices, highlighting the significance of brokers in promoting stakeholder dialogues; it scrutinises the use and effectiveness

of visualisation media at longitudinal planning processes, suggesting using a range of visualisation media can facilitate planning communication, stakeholder awareness, cultural rehabilitation, and political attitudes; it investigates the influence of visualisation types and stakeholder characteristics on stakeholder perceptions of planning, providing implications for better utilisation of visualisation media to meet diverse stakeholder needs. The findings of the three case studies reveal no significant differences between the general public and professionals in perceptions of planning, suggesting the general public plays a more substantial role in planning and decision-making processes. To form a more comprehensive picture of stakeholder participation and visualisation in China, future research is needed to examine the research questions in other cultural, social and political contexts.

Table of Contents

List of Figures

List of Tables

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Dedication

The work presented in this thesis is original work conducted by the author from September 2017 to October 2021 at the Department of Landscape Architecture, University of Sheffield. Part of this work has been published in peer-reviewed journals or are under review. Copyright permissions are included in Appendix A.

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Code and abbreviation

AUPE	Association of Urban Planning Exhibition
CPGRPC	The Central People's Government of the People's Republic of China
GLPRC	Guangzhou Land Resources and Urban Planning Commission
HKTDC	Hong Kong Trade Development Council
HURDB	Housing and Urban Rural Development Bureau (city level)
HURDD	Housing and Urban Rural Development Department (provincial level)
LRUPB	Land Resources and Urban Planning Bureau
MCAPRC	Ministry of Civil Affairs of the People's Republic of China
MHURC	Ministry of Housing and Urban-Rural Construction of the People's Republic of China
MoC	Ministry of Construction
NPC	National People's Congress
NPCSC	Standing Committee of National People's Congress
PRC	The People's Republic of China
PRD	Pearl River Delta
ROGMPG	Research Office of Guangzhou Municipal People's Government
SAR	Special Administrative Region
SCPC	Standing Committee of People's Congress
UPEH	Urban Planning Exhibition Hall
URPL	Urban and Rural Planning Law of the People's Republic of China

Chapter 1 - Introduction

1.1 Rationale for the study

It has been widely argued that the integration of multi-stakeholder insights, intelligence and perspectives is of fundamental importance in achieving a fair and sustainable planning (Mahjabeen et al. , 2009; Prell et al., 2009b; Reed, 2008). Following Freeman (1978, p.46), stakeholders might "affect or be affected by the achievement of the organisation's purposes". In Western societies, great importance has been attached to stakeholder participation in planning processes, as demonstrated, for example, in the Rio Declaration on Environment and Development (The World Bank, 1996) and the European Landscape Convention (Council of Europe, 2004).

Many would perhaps assume a lack of proper multi-stakeholder engagement in China's policy-making (Wong, 2013), on the basis of the unique relationship between the Chinese people and the state, the specificities of the centralised system of government, and a history characterised by collective action and mobilisation (Plummer & Taylor, 2013). The distinct political, cultural, and economic contexts of China make participation here quite different from participation in Western democracies built on the principle of majority rule.

However, the transition from a centrally planned economy towards a market economy in China has provided a new context for stakeholder participation. While political decision-making takes place at a high level, due to the party-state nature of the country, a bottom-up planning process has been emerging featuring political decentralisation, stakeholder interaction, and the inclusion of civil society (Zhao, 2015). Some new participatory mechanisms for bridging stakeholder dialogues,

such as community planners and chief urban designers, have been formed based on this context (Rui, 2019; Sun et al., 2019). So far, however, hardly any systematic analysis has been conducted to explore the operation of stakeholder participation in contemporary Chinese planning processes.

Communication plays a key role in effective stakeholder participation. Since most stakeholders are not planning professionals, effective communication requires that information be delivered in an easily understandable way. According to Bruce et al. (2003), humans sense their surroundings through various perceptual systems: hearing, touch, movement, balance, smell, taste, and vision; but 80 per cent of human perception is grounded on the visual sense. Thus, visualisation plays a crucial role in supporting dialogue between policy makers, planners, and the general public.

Traditional visualisation tools, including plans, sections, sketches, perspective drawings, photomontages, and models, have been utilised for a long time. With technical developments, more advanced digital applications such as 3D visualisation, Geographic Information Systems (GIS), Virtual Reality (VR), and Augmented Reality (AR) are playing an increasingly important role in planning communication (Bishop & Lange, 2005). Although great efforts have been made to evaluate the effectiveness of different visualisation tools (Dockerty et al., 2005; Gill et al., 2013; Wissen Hayek et al., 2019), they have primarily focused on a particular site or regional scale. A multi-scalar approach that examines the application of visualisation tools in planning processes is still lacking (Lewis, 2012; Orland, 1992; Shaw et al., 2009).

China's administrative division consists of five "de jure" planning levels: national, provincial, prefectural, county, and township. In practice, the "basic-level autonomy" afforded to village and

community committees constitutes the fundamental local authority. The administrative division maps onto the Chinese urban planning system, which features national/provincial hierarchical planning, city planning, town planning, township planning, and village planning (Urban and Rural Planning Law of People's Republic of China, 2008). In principle, plans should be formulated by government authorities at the relevant level and submitted to a higher administrative level for examination and approval.

Conventional visualisation tools used for planning communication in China include text, 2D images, and 3D rendering (MHURC, 2010, 2011). Yet, the operation of these visualisation media in multi-level planning practices remains underexplored. The Urban Planning Exhibition Hall (UPEH), which is widely established across China as a means of presenting past, present, and future planning in a particular geographic area, stands out among the various participatory tools. It presents multi-level planning information in various advanced forms (Lu et al., 2020). However, according to the Arnstein model (1969), the UPEH is positioned at the lowest level of citizen participation; that is, its aim is only to inform stakeholders. Understanding its effectiveness in stakeholder participation and planning communication is essential.

1.2 Research questions, aims and objectives

This research aims to provide a multi-scale overview of stakeholder participation and visualisation in the Chinese urban planning system. It will look into institutional arrangements and local practices across different planning scales and examine how stakeholder participation and visualisation vary and interact. Specifically, the thesis explores the following three research questions:

1. **How does stakeholder participation work, and how effective is it at different levels of statutory planning?**

This question examines the operation of stakeholder participation at different planning levels and details its effectiveness following a comprehensive stakeholder analysis process.

2. **How effective are the different visualisation media used to communicate planning proposals throughout the planning process?**

This inquiry analyses the types of visualisation media that are utilised at various planning levels and phases, as well as their effectiveness.

3. **How do stakeholder characteristics and visualisation media vary and interact at different scales of planning practices?**

This question examines the effect of stakeholder characteristics (age, ethnicity, gender, education level, stakeholder categories) and visualisation media (presentation format, size) on stakeholder perceptions of planning and design.

1.3 Contribution to knowledge

The thesis provides a multi-scalar overview of the complex nature of stakeholder participation and visualisation in the Chinese planning process. The study:

- is one of the first to critically scrutinise the institutional arrangements and operational management of stakeholder participation and visualisation in the Chinese planning process, with the goal of informing policy formulation and planning implementation;
- examines the effectiveness of UPEHs through a mixed-method approach and develops guidance for improved communication and public engagement;

- analyses the efficacy of newly emerging participatory mechanisms, such as community planners and chief urban designers, for facilitating stakeholder interaction in contemporary Chinese planning practices;
- investigates how visualisation media and stakeholder characteristics influence stakeholder perceptions of planning, providing insights for using visualisation media to meet diverse stakeholder needs.

1.4 Scope of the study

The Pearl River Delta (PRD) in the southern part of China (Figure 1-1a) covers nine cities in Guangdong Province, namely Guangzhou, Shenzhen, Zhuhai, Dongguan, Zhongshan, Foshan, Huizhou, Jiangmen, and Zhaoqing. It also includes the special administrative regions (SARs) of Hong Kong and Macau. With the Chinese reform and opening up since 1978, the PRD has become a microcosm of China's rapid economic and social development, being the largest urbanised area in the world in both size and population (The World Bank, 2015). It differs from Beijing in terms of policies, actors and institutional contexts, allowing more democracy in local governance and social participation (Zhang et al., 2019). This provides a lens for understanding state–market–civil society relations in current planning processes. Three case studies were chosen to represent different planning levels (provincial, subdistrict, residential community) in the PRD, with newly emerging participatory mechanisms, high social impact, and rich use of visualisation tools (Figure 1-1b).

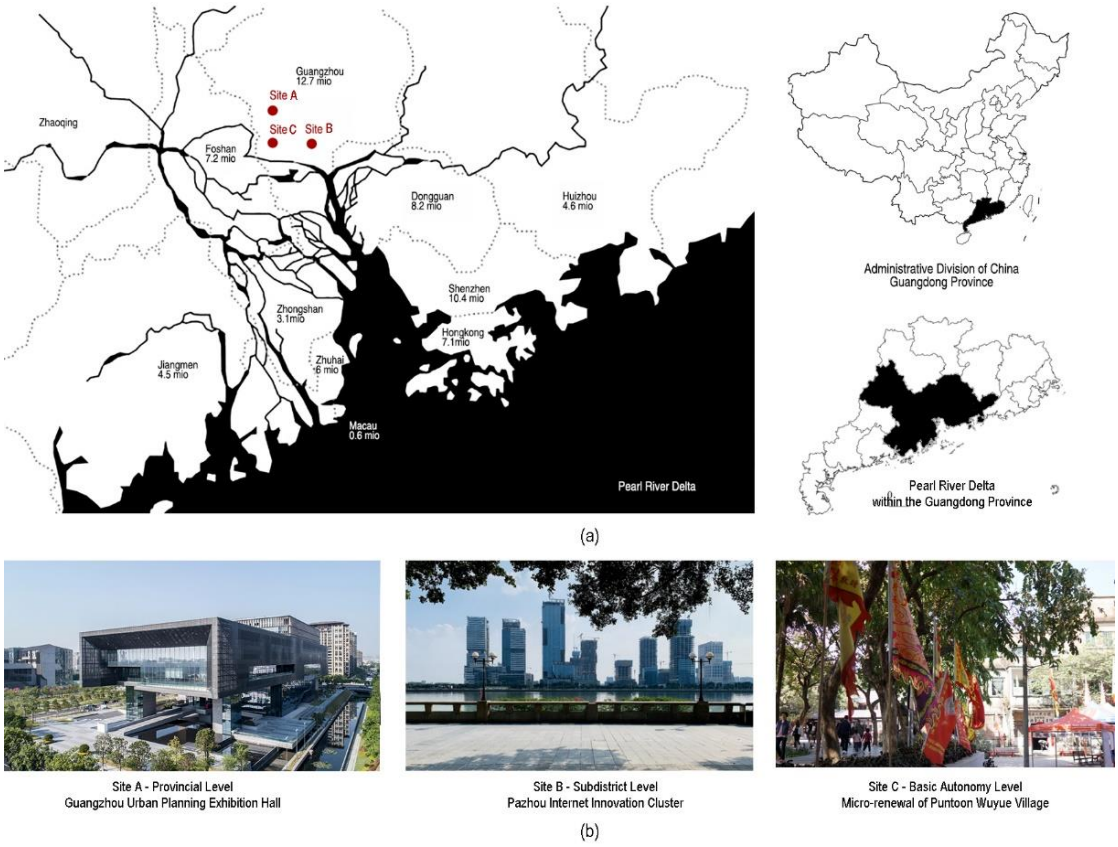


Figure 1-1 The geographical location of the PRD and three case studies

(a) geographic location of the Guangdong province and the PRD area; (b) three case studies associated with different administrative levels and planning processes

1.5 Thesis structure

This thesis consists of seven chapters connected by two structural diagrams, of the Chinese urban planning system and China's administrative divisions, respectively. These institutional arrangements are introduced in detail in Chapter 3. Three case studies that address different levels of the planning system (Figure 1-2) and administrative divisions (Figure 1-3) are presented in Chapters 4, 5 and 6. Research questions 1 and 2 are addressed in Chapters 3–6; research question 3 is explored through three case studies in Chapters 4–6 (Figure 1-4). Chapter 7 concludes this thesis.

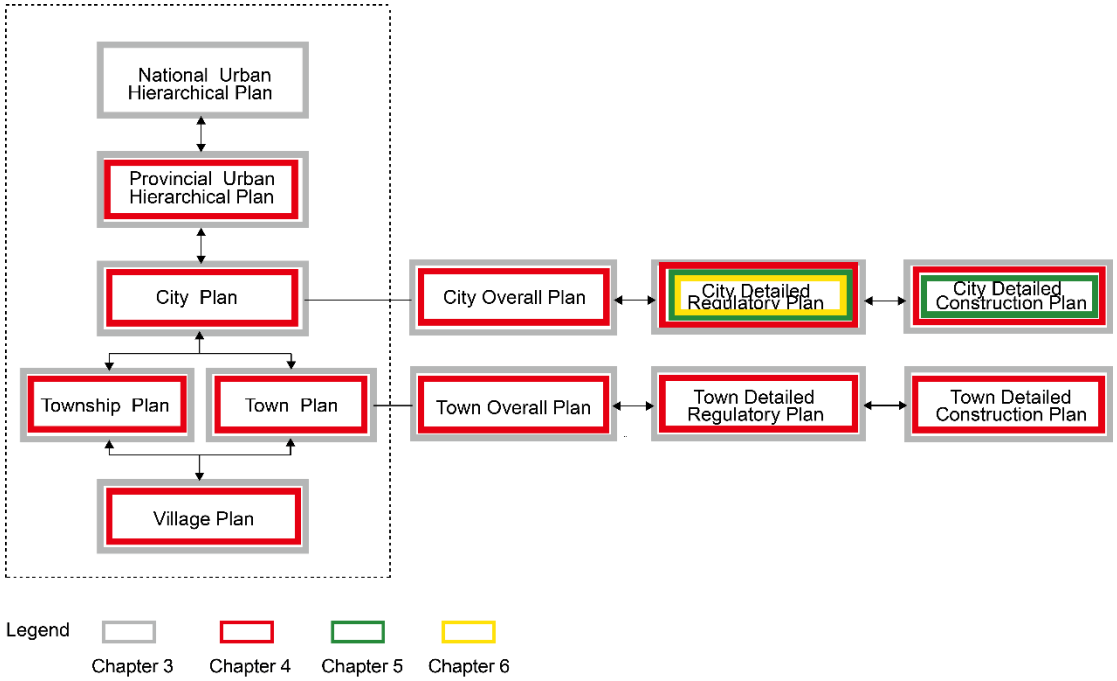


Figure 1-2 Chinese urban planning system

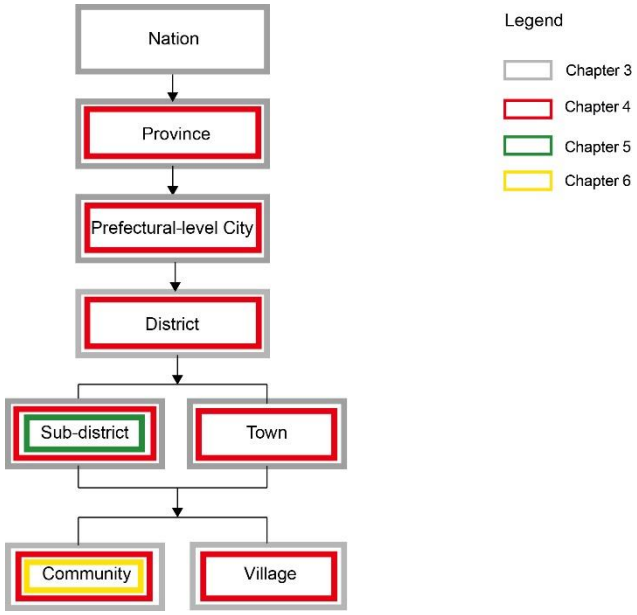


Figure 1-3 Administrative divisions in the planning process

Chapter 2, “Literature review: Stakeholder participation and visualisation media”, introduces the studies that inform the theoretical foundations of the research. These include studies on framework analysis, stakeholder analysis and public perceptions of visualisations.

Chapter 3, “Stakeholder participation and visualisation in the Chinese urban planning system”, provides detail about China’s administrative structure and urban planning system. It scrutinises the statutory requirements for, and the effectiveness of, stakeholder participation and visualisation media.

Chapter 4, “Provincial level – The Urban Planning Exhibition Hall”, introduces the phenomenon of UPEHs in China, with a specific focus on the PRD region (provincial level). It examines the role of the UPEH in planning communication and stakeholder participation, and participant perception of various visualisation media.

Chapter 5, “Subdistrict level – Pazhou Internet Innovation Cluster”, investigates the detailed regulatory plan and detailed construction plan of an e-commerce cluster at subdistrict level. It investigates how stakeholders interact with each other, and how they perceive and respond to the two planning scenarios.

Chapter 6, “Community level – Micro-renewal of Puntoon Wuyue Village”, looks at an urban renewal project at the residential community level. It analyses the stakeholder interaction and stakeholders’ perceptions of visualisation media from a longitudinal perspective.

Chapter 7, “Conclusion and outlook”, conducts a descriptive comparison of institutional arrangements and planning practices, providing implications for policies and practices involving the use of visualisation tools to encourage stakeholder participation.

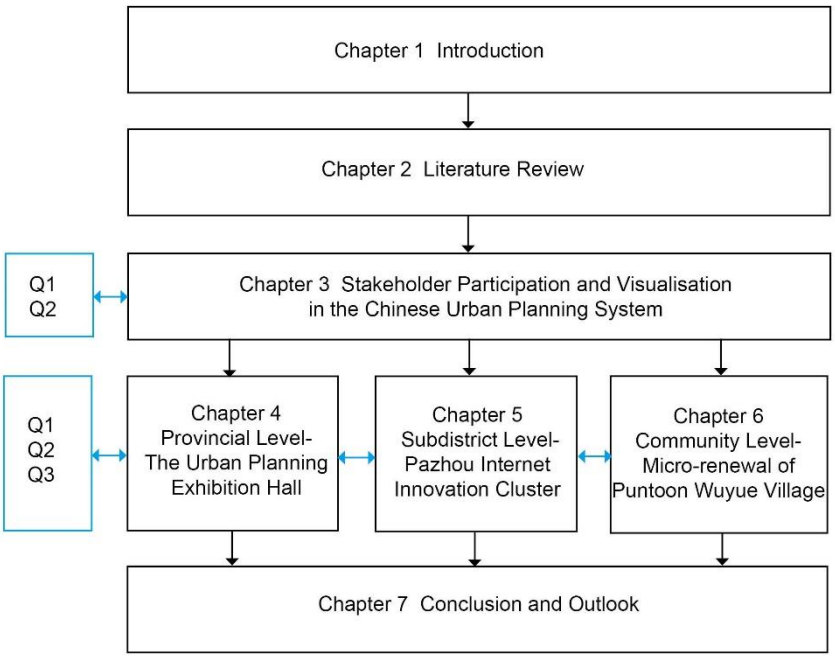


Figure 1-4 Thesis structure

1.6 Methodological framework

The thesis adopts a mixed-method approach comprising document analysis, ethnographic observation, interview, questionnaire, observation, and gaze tracking techniques. Table 1-1 shows the synthesis of the methods and the application in the relevant chapters to address different research questions.

Table 1-1 Methodological framework and their connections with research questions and chapters

Category	Methodology	Application	Research question
Qualitative approach	Document analysis (laws, regulations, rules, news media, internet etc.)	Chapter 2, "Literature Review: Stakeholder participation and visualisation media"; Chapter 3, "Stakeholder participation and visualisation in the Chinese urban planning system"; Chapter 5, "Subdistrict Level – Pazhou Internet Innovation Cluster"; Chapter 6, "Community Level – Micro-renewal of Puntoon Wuyue Village"	Q1, Q2
	Ethnographic observation	Chapter 5, "Subdistrict Level – Pazhou Internet Innovation Cluster"; Chapter 6, "Community Level – Micro-renewal of Puntoon Wuyue Village"	Q1, Q2, Q3
	Interview	Chapter 4, "Provincial Level – Urban Planning Exhibition Hall" used a walking interview during visitors' visiting; Chapter 5 and Chapter 6 adopted open-ended interviews with different stakeholders	Q1, Q2, Q3
Quantitative approach	Questionnaire	Chapter 4 adopted a repeated measure design (pre- and post- questionnaire); whereas Chapter 5 and Chapter 6 conducted summative questionnaires regarding stakeholder perceptions	Q1, Q2, Q3
	Participants' observation and tracking	Chapter 4, "Provincial Level – Urban Planning Exhibition Hall" used note-taking and behavior-tracking methods in relation to participant interaction with the visualisation media; Chapter 6 adopted 3D gaze-tracking identifying stakeholders' foci in the virtual environments	Q3

1.7 Definitions of key terms and concepts

Administrative division of China

The administrative division of China consists of five "de jure" levels, including national, provincial, prefectural, county, and township (CPGPRC, 2005). In practice, a sixth level named basic-level autonomy serves as an organisational division at the neighbourhood scale and has limited political power. The detailed classification is addressed in Section 3.1.

City

The Chinese word "市" (pinyin: shì) is often loosely translated into English as "city". However, it could represent areas at different administrative and political levels. In this thesis, the term "city" refers to cities at provincial level, prefecture level and county level.

Chinese urban planning system

The urban planning system is associated with the administrative structures of China. It includes hierarchical planning, city planning, town planning, township planning and village planning. A city or town plan is further divided into an overall plan and a detailed plan. A detailed plan includes a detailed regulatory plan and a detailed construction plan (Urban and Rural Planning Law of People's Republic of China, 2008).

Demonstration

Demonstration is also called "seminar", or "expert panel". It is a tool frequently used in China, seeking experts' advice for improving planning and design, particularly for projects that will have a great social impact.

Hearing

Originated from the United Kingdom and the United States, hearing introduces the model of judicial trial into administrative and legislative procedures (China Net, 2012). In the Chinese statutory planning process, hearings should be held when the planning process includes the general concern of the society or has a significant impact on the rights of citizens, legal persons or other organizations (LRUPB of Guangzhou, 2014).

Symposium

It is conducted by a well-trained moderator on a small group of respondents in an unstructured manner. The main purpose is to extract a group of people from the appropriate target population and get ideas by listening to topics they are interested in talking about. The value of this approach is that free group discussions often yield unexpected discoveries (Sogou, 2016).

Government website

Planning decisions can be announced through the publicity columns of relevant government websites, including People's Congress, and the competent department in charge of urban and rural planning at different planning levels (MHURC, 2013).

On site publicity board

Posting planning related content on the main street of the planned plot, the notice board of the village, or setting up a public notice board on the construction site.

The next sequence of paragraphs explain how terminology is used in the Chinese planning system, how this compares to usage elsewhere, and how relevant terms are used in this thesis.

Design institute and design companies

"Design institutes" in this study refer to design practices in China that have some affiliation with universities or governmental authorities; the scope of work often focuses on municipal projects. "Design companies", on the other hand, are privately owned domestic or foreign firms whose work is more tied to commercial industries and consulting services.

Development phases

A typical planning project undergoes formulation, revision, implementation, and supervision. Stakeholder participation is encouraged throughout the process as stipulated in the 2008 Urban and Rural Planning Law of People's Republic of China.

Planning scale

Following the Chinese administrative structure and the Chinese urban planning system (detailed in Chapter 3), the thesis focuses on six interconnected scales, including the national, provincial, city, town, township, and community (or village).

Public and stakeholder

"Public" and "stakeholder" are terms often used interchangeably in participatory planning studies; Official documents in China tend to use the term "public participation" (Chinese:公众参与; pinyin: gong zhòng cān yù) to encourage the general public to participate in planning processes – in contrast to traditional decision-making processes where government authorities dominate. In this thesis, "stakeholder", following Freeman (2010), is understood as being able to affect or be affected by organisational outcomes. The "public" is regarded as the broad range of people with an interest in the outcome –while not included in any other stakeholder group. Unless translating from original documents, I use the term "stakeholder participation" to refer to multi-player interaction.

Publicity

When urban and rural planning authorities are performing the formulation, revision, implementation and supervision of urban and rural planning, "publicity" (pinyin: gōng shì) refers

to the means through which they disclose relevant information to consult opinions, collect feedback, and perform management and supervision.

Virtual environments and virtual reality

"Virtual environments" and "Virtual Reality" generally refer to spatial environments produced by computer displays to allow users the illusion of "being there" (Schroeder, 2008). In this thesis, the term "Virtual Reality" (VR) refers to the specific visualisation device such as headset or desktop devices (see Section 2.2.1), while "virtual environment" refers to the more general digital spatial environment.

Visualisation

The term *visualisation* is used in a broad sense and comprises analogue and digital representation of data for aiding comprehension of planning. "visualisation media" and "visualisation tools" are interchangeably used in the thesis. In this thesis, visualisation media includes the use of text, sketch and notes, 2D maps, 2D plans, photos, 3D physical models, 3D computer-generated renderings, animation, 4D visualisation, virtual reality and so on.

Urban planning exhibition area

It includes urban planning exhibition halls (UEPH) and other exhibition places announced by the relevant urban and rural planning department (LRUPB of Guangzhou, 2014). As of 2017, there are 3437 planning exhibition halls being built across the nation, completely covering first-tier cities (e.g. Shanghai, Beijing, Guangzhou, Chongqing), basic coverage of second-tier cities (e.g. Hangzhou, Dalian, Harbin), and partially covering third-tier cities (e.g. Yancheng, Zhenjiang, Yangzhou). The urban planning exhibition hall is a platform to show the past, present and future

planning of a particular geographic area (Lu et al., 2020). Planning communication, public participation, cultural heritage, and city memory are four standard functions of the UPEH (AUPE, 2016).

Urban design

"Urban design" is the overall conception and arrangement of urban environments. Though urban design is gaining great popularity in China, it is not included in statutory planning. The content of urban design in Chinese urban centres is often integrated into detailed regulatory planning. Urban design focuses on urban form of a proposed development; the latter, in addition, includes a series of indices related to actual construction, such as sunshine analysis, municipal engineering, vertical planning, and investment estimation (THUPDI, 2017).

Chapter 2 - Literature review: Stakeholder participation and visualisation media

This chapter reviews studies that lay the theoretical framework for this research. It explains the term *stakeholder participation* and traces how it has gradually evolved in the planning process. It examines the advantages and disadvantages of different stakeholder analysis methods, providing implications for choosing appropriate approaches for stakeholder analysis in each case study. It reviews the historical evolution of visualisation media in planning, focusing on its application at different scales and stages across the disciplines of architecture, urban planning, and landscape and environmental planning. Finally, it explores how stakeholders perceive visualisation media and the factors that can affect their perceptions.

2.1 Stakeholder participation and analysis

2.1.1 Definition of stakeholder participation

Stakeholder and *participation* are interpreted differently in various contexts. Generally, *stakeholder* refers to "any group or individual who can affect or is affected by the achievement of an organisation's objectives" (Freeman, 2010, p.46). Stakeholders vary in their interests and power concerning a particular issue. They have distinct roles and responsibilities, and they generate and consume knowledge in various ways (Davies & White, 2012). *Participation*, building on Reed et al. (2018) and the European Institute for Public Participation (EIPP) (2009), is defined as a deliberative process, where individuals, groups, and organisations participate in the decision-making prior to the adoption of a political decision.

The advantages of stakeholder participation can be classified broadly into normative and pragmatic arguments (Reed, 2008). Normative claims centre on democratic services, citizenship, and equity. Participants may increase trust and transparency in the decision-making process; incorporate people of diverse values and needs (Richards et al., 2004); and foster social learning through newly established relationships (Blackstock et al., 2007; Pahl‐Wostl & Hare, 2004). Pragmatic statements concentrate on the quality and durability of decision-making during stakeholder engagement. Participation makes the administrative process more adaptable to the local contexts and stakeholder needs (Reed, 2007) which leads to high-quality decisions, and the anticipation and amelioration of unwanted outcomes before they occur (Newig, 2007).

2.1.2 Stakeholder participation in planning: History and development

The term *stakeholder participation* dates to the civil society concept in the ancient Greek city-state, but it was not until 1954 that it became legalised in the Town and Country Planning Act in the UK. As a critique of synoptic planning, Arnstein (1969) set out a ladder of citizen participation which structured the gradations of participation in terms of three groups of power: "nonparticipation (manipulation, therapy), tokenism (informing, consultation, placation), and citizen power (partnership, delegated power, citizen control)". Since then, a series of conceptual and ideological changes regarding stakeholder participation has been proposed, encouraging collaboration between government and the public or the empowerment of the public.

For example, Habermas (1979) suggested participation should be "fair", representing all associated stakeholders and equalising power among participants. Forester (1982) developed Habermas's ideas and proposed that planning is a negotiation process with inherent misinformation or communicative distortions for structural reasons. As such, the role of planners as gatekeepers is

highlighted in facilitating the communication process. Expanding on the work of Forester (1982), Healey (1996) focused on the spatial, economic, and environmental aspects of planning; she promoted "collaborative planning", highlighting the impact of communicative acts in a communicative planning process. Similar to Healey, Innes (1996) developed "communicative planning", where she advocated consensus building for participant engagement in the local comprehensive planning process. Thus, planning gradually evolved from a rational comprehensive process into one of collaborative communication.

Although the increasingly important role that collaborative planning plays in the current planning process, it is not without its critics. Some doubts exist as to whether the idealist consensus-based process could lead to authentic outcomes in a real world limited by political and institutional contexts. Others question whether the goal reached by consensus is really valuable in the process of gradually made critical planning decisions (Tewdwr-Jones & Allmendinger, 1998). Yet other critiques are concerned about the uneven power distribution between stakeholders, affecting the consensus-building process (Flyvbjerg, 1998).

There are also concerns concerning the application of stakeholder participation in cross-cultural contexts. As Li et al. (2020) and Midgley et al. (1986) maintained, the progress and achievements of stakeholder participation in Western contexts have primarily depended on institutionalised reciprocity and communal self-reliance. Owing to differences in cultural, social, and political contexts, these models may not apply to developing countries, where there has been less emphasis on citizen participation. This point is also highlighted by Plummer & Taylor (2013), who claimed

that stakeholder engagement schemes in China differ from those in Western societies due to the historical background and unique relationship between the state and the people.

While political decision-making takes place at the formal policy level, due to the party-state nature of the country, a bottom-up planning process has been emerging featuring political decentralisation, market economy approaches, and stakeholder participation (Zhao, 2015). The planning process now involves more internal and external actors. Yang and Chang (2007) and He and Wu (2005) have observed the pro-growth coalitions between developers and local governments for property-led redevelopment projects. Journalists and social capital were found to lead collective actions regarding redevelopment interventions (Lee, 2016; Zhai & Ng, 2013). Furthermore, some planners have made efforts to forge a dialogue between residents and government officials (Li et al., 2020; Liu et al., 2019; Yan et al., 2018). Existing studies on stakeholder relationships often rely on descriptive approaches, while a systematic understanding of the stakeholder network within the Chinese planning process is still lacking.

2.1.3 Methods for stakeholder analysis

Stakeholder analysis is a process used to identify stakeholders and their interests as well as assess their influences and relationships (Brugha & Varvasovszky, 2000). One well-received framework for stakeholder analysis, developed by Reed et al. (2009), entails three stages: 1) identifying stakeholders, 2) differentiating and categorising stakeholders, and 3) investigating the relationships between stakeholders. Various methods have been proposed for each step, the choice of which depends on the research focus, the researchers' available resources, and how the stakeholders interact (Yang et al., 2011). Social network analysis (SNA) applies network science to social networks and is often used to map and measure social relations. It focuses on one-to-one

stakeholder relationships and, thus, can be tedious and time-consuming for the participants, who are required to fill in the surveys (Prell et al., 2009). While the aforementioned tools often focus on key stakeholders, the radical trans-activeness approach emphasises the needs of the marginalised groups (Hart & Sharma, 2004).

Table 2-1 summarises the commonly used methods with their pros and cons, informing the methodology for stakeholder analysis in different case studies. Due to time and motivation constraints, not all the steps will be conducted in real-world practices (Reed, 2008).

Table 2-1 Commonly used methods for stakeholder analysis and their associated pros and cons
Adapted from: Brugha & Varvasovszky (2000); Reed et al. (2009); Yang et al. (2011)

Step	Method	Description	Example	Pros (+) /Cons (-)
Identify stakeholders	Expert judgement	Experts who know the sector, policy, and players help to identify the stakeholder lists	Schmeer (1999)	+: save time and cost –: based on the opinions of the analysts, without considering different views of stakeholders.
	Focus group	A small group of people brainstorming stakeholder characteristics	Reed et al. (2009); Prell et al. (2009)	+: flexible, efficient –: less structured than other alternatives
	Semi-structured interview	Interview with different stakeholders to check/supplement focus group data	Prell et al. (2009); Dougill et al. (2006)	+: gain deep insight into the stakeholder network and facilitate data triangulation –: time-consuming; difficulty in reaching consensus
	Snow-ball sampling method	Existing stakeholders provide referrals to recruit new samples required	Prell et al. (2009)	+: easier to conduct interviews –: bias could occur due to the first participant approached in the entire network
Categorise stakeholders	Influence-Interest matrix	Stakeholders are tabulated in a grid based on their levels of influence and interest	Ackermann & Eden (2011);	+: make power-interest dynamics explicit –: lack in-depth information about stakeholders' roles, perspectives, issues, and challenges.
	Stakeholder circle methodology	Stakeholders are distributed in a circle based on their power, intimacy, and urgency	Bourne and Walker (2005)	+: inward, onward and outward of different stakeholder characteristics –: prioritisation may result in marginalisation of stakeholders

Table 2-1 continued

Categorise stakeholders	Method	Description	Example	Pros (+) /Cons (-)
	Stakeholder salience model	Stakeholders are identified and prioritised according to their power, legitimacy and urgency	Mitchell et al.(1997)	+: add on the dimensions of legitamacy and urgency compared to influence-interest –: prioritisation may result in marginalisation of stakeholders
	Stakeholder-led categorisation	Stakeholder themselves categorise stakeholders into relevant categories	Hermans and Thissen (2009)	+: simple and fast –: inconsistency between self-assessments of different stakeholders
	Q - methodology	Stakeholders rank the importance of given concourse identified by earlier focus groups	Davies and Hodge (2007);	+: individuals can be classified based on how well they 'fit' into various social discourses surrounding a given subject. –: only discourses presented will be discussed
Understand stakeholder interaction	Actor-linkage matrix	Stakeholders are mapped in a two-dimensional tablet and their relationship were described by codes	Biggs and Matsaert (1999, 2004)	+: relatively easy, require less resources –: can be confusing and hard for interpretation when many actors are involved
	Actor-linkage map	Stakeholders' relationships are drawn using diagrams	Biggs and Matsaert (1999, 2004)	+: clearly illustrate relationship between a small number of stakeholders –: can be confusing and hard for interpretation when many linkages are involved
Understand stakeholder interaction	Social network analysis	Identify stakeholder boundary and relations based on social relations	Prell et al. (2009); Lienert et al. (2013);	+: gain insight into the boundary of stakeholder network and the structure of the network –: tedious for respondents and time-consuming
	Knowledge mapping	Used in combination with Social Network Analysis, provide information about who knows what	Daly et al. (2002)	+: identify stakeholders that can cooperate and those with power dynamics –: knowledge needs may not be addressed due to differences in knowledge held and needed by stakeholders
	Radical transactivenes s	identify, investigate, and incorporate the stakeholders' perspectives on the "fringe"	Hart and Sharma (2004);	+: identify stakeholders and issues that might be neglected –: results may be distracting, time-consuming and costly

2.1.3.1 Stakeholder identification

Stakeholder identification is a process of determining who is the stakeholder of the project, which is a prerequisite for participatory planning. While stakeholder identification is a fundamental step

in stakeholder management, it is often an iterative process where more stakeholders are added as the project progresses. Since it is not possible to incorporate all the stakeholders, it is vital to set a stakeholder boundary before analysis. For this purpose, a combination of methods, such as focus groups, interviews, expert opinions and snowball sampling methods, have been proposed (Prell et al., 2009).

2.1.3.2 Stakeholder categorisation

Stakeholder categorisation refers to the classification of stakeholders based on specific characteristics. It can be conducted using top-down and bottom-up methods. Bottom-up approaches, such as Q-methodology, in which stakeholders rank the importance of a given set of items identified by earlier focus groups (Davies & Hodge, 2007) or stakeholder-led categorisation, in which stakeholders categorise themselves into relevant categories (Hermans & Thissen, 2009), rely on their self-evaluation. This frequently results in discrepancies between different stakeholders' perceptions of category classification.

Using top-down approaches could avoid such inconsistencies. The influence-interest matrix, for example, compares stakeholders' power and interest level and visually displays the pattern of the stakeholders' distributions (Ackermann & Eden, 2011). A few variants have been developed based on the influence-interest matrix, such as the alignment, interest, influence matrix, the salience map, revealing attributes of power, legitimacy, and urgency, and the stakeholder circle methodology. A drawback shared by these top-down methods is that the prioritisation of particular stakeholder groups may marginalise the others (Prell et al., 2009).

2.1.3.3 Stakeholder interaction

Stakeholder interaction analyses the relationship between various stakeholders. This is often achieved through an actor-linkage matrix/map, social network analysis, knowledge mapping, and radical trans-activeness methods. An actor-linkage matrix is a table in which an individual stakeholder or a stakeholder group is tabulated in both rows and columns. Keywords, such as communication frequency and attitude, are used to describe stakeholder relationships (Biggs & Matsaert, 2004). It keeps a holistic perspective of the entire network and pinpoints linkages between specific groups. Compared with the actor-linkage map, an actor-linkage matrix can be adapted to more complex situations and more actors.

Social network analysis (SNA) applies network science to social networks and is often used to map and measure social relations. It focuses on one-to-one stakeholder relationships and, thus, can be tedious and time-consuming for the participants, who are required to fill in the surveys (Prell et al., 2009). While the aforementioned tools often focus on key stakeholders, the radical trans-activeness approach emphasises the needs of the marginalised groups (Hart & Sharma, 2004).

2.2 Using visualisation media for stakeholder participation

2.2.1 A brief history of visualisation media

Visualisation media comprise analogue and digital tools. Traditionally, analogue methods for visualising planning and design − which are still broadly employed − include texts, maps, sections, perspective drawings, photomontages, and physical scale models (Lange, 1994). Physical models and sketches are the longest established, evidence of which can be traced back to the ancient civilisations of Mesopotamia, ancient Egypt, ancient India, and ancient China, such as those found in ancient Chinese tombs (Zube et al., 1982).

The use of paintings emerged in prehistory when nomadic people made paintings on rock walls or in caves. Due to their 2D nature, paintings and/or drawings fail to describe the relationship between objects clearly within the image frame. This is somehow addressed by perspectives, developed in Greece around 465BC to create a sense of depth for a flat surface (Gondek, n.d.). Perspective was reinvented in the Renaissance as a commonly used tool for final architectural designs. Examples of perspectives can be found in the mural in the Bardi Chapel of Santa Croce of Florence (after 1377) (Hagiioannu, 2001) and the use of the "vanishing point" applied to sketch the Florence Baptistry by Fillippo Brunelleschi, approximately a century ago (Smith, 2005).

An example application of perspectives is Humphry Repton's (1803) Red Books for communication with his clients. He depicted the existing conditions and proposed changes by flipping over two slides hinged together at the bottom of the page (Zube et al., 1987) (see Figure 2-1). A specific branch of perspectives is that of panoramas, created and patented by Robert Barker (1739–1806) in 1787 (Otto, 2007). Applications of panoramas are evident in various depictions, including war scenes, landscapes, and other landmarks (Smith, 2005).

(a) Before: Repton's drawing showing Attingham Hall and the river to the front

(b) After: Repton made proposals for widening the river to appear more like a lake.

Figure 2-1 Repton's approach to landscape representation of Attingham Park, the UK in 1797

Although analogue tools are still widely used, digital tools are gaining increasing popularity because of ease of editability, replication, and mobility (Cantrell & Yates, 2012). In the late twentieth century, the widespread use of desktop devices brought users an automated and editable process. Applications such as Computer-Aided Design and Geographical Information Systems (GIS) can help to produce nuanced maps (Brindley et al., 2018) and pre-rendered 3D models using sophisticated spatial data and aerial photography (Lange, 1994). A drawback of these tools is that the representation is fixed and static, making it difficult for non-specialists to understand the full picture (Gill & Lange, 2018).

The recent development of specialised computer hardware and computing methods allows eye-level walkthroughs in immersive virtual environments (Morgan et al., 2009). The rise of virtual reality (VR) and augmented reality (AR) permits the exploration of planning scenes, both on-site and off-site. In mixed reality (MR), the physical and immersive worlds are blended, facilitating interaction between humans, virtual elements, and the physical environment (Flavián et al., 2019; Piga et al., 2011).

Visualisation media are classified differently. Al-Kodmany (2002) and Caldwell and Woodward (2012) grouped different visualisation tools into analogue and digital tools, depending on their use of manual crafted methods or human-computer interaction forms. Zube et al. (1987) categorised visualisation media based on their use for perceptual or conceptual information, further divided into static or dynamic representations. Piga and Morello (2015) classified visualisations into four types: "matrix images, sequence of images, videos, and virtual reality". Building on these studies, in this research, visualisation tools are classified into analogue and digital devices, further broken down into static and dynamic presentations, admitting that no category is mutually exclusive (see Figure 2-2).

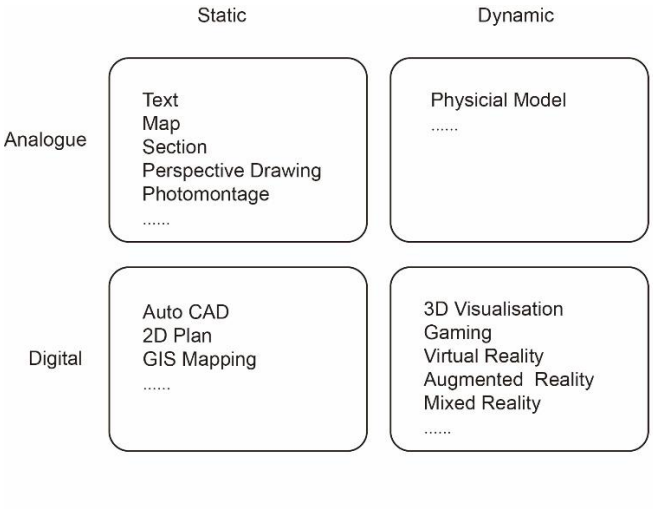


Figure 2-2 Classification of visualisation media

2.2.2 Application of visualisation media in multi-scale planning processes

Scale is perceived and used differently in various contexts. In cartography, it is considered to be "the ratio between a distance on a map and its corresponding distance in the real world" (Dabiri & Blaschke, 2019). In policy, it is referred to as "where the decisions are made or the policy is implemented" (Wu & Li, 2009). In the UK's spatial planning system, it is categorised into national, regional and local levels, despite also being influenced by global and European-scale policies

(Wilson, 2009). In landscape ecology, it is divided into three layers: region, locality and site (Steiner, 2012). While many present studies characterise scales in line with territorial boundaries, in a social context, one's perception of scale could be inherently related to the one's understanding of the neighbourhood (de Almeida Célio et al., 2018).

Building on Pettit et al. (2012), this literature review focuses on scales related to the spatial extent of geographical coverage, namely national/continental, regional, local/site scales. Table 2-2 summarises the examples of multi-scale visualisation applications of participatory design across the disciplines of architecture, urban planning, landscape, and environmental planning. Particularly, it looks into different development stages of planning, including inventory and analysis, planning and design, examination and decision-making and, finally, implementation and post-occupancy (Pettit et al., 2012; Wissen Hayek, 2011b).

Table 2-2 Application of visualisation media in multi-scale participatory planning process

Planning Scale	Inventory & Motivation	Planning & scenario modelling	Evaluation & Decision-making	Implementation & Post-occupancy
Global/National		Pettit et al. (2012); Shaw et al.(2009); Wong et al. (2009)		
Regional	Hehl-Lange (2001); Williams et al. (2009)	Barredo et al. (2003); Ford et al. (2019); Pettit et al. (2012); Shaw et al.(2009)	Grêt-Regamey et al. (2008); Jern & Nilsson (2002)	
Local/Site		Dockerty et al. (2005, 2006); Ford et al.(2019); Jude et al. (2006); Pettit et al.(2011); Pettit et al. (2012); Shaw et al. (2009); Tress & Tress (2003);	Lange (2001); Lokka (2019); Slater et al. (2009); Sheppard (2005); Tress and Tress (2003)	Bouchlaghem et al. (2005); Downes and Lange (2015); Yabuki et al.(2010)

At a global or national scale, few examples of visualisation used for participatory contexts exist across three disciplines because few meaningful decisions are made at this scale (Pettit et al., 2012). Some studies exist related to scenario building and evaluation for national disasters. For instance, Wong et al. (2009) developed a collaborative visual analytics tool to forecast the effects of global climate change on power grids and the national security of the United States, while Shaw et al. (2009) produced scenarios showing climate change on the worldwide scale landscape pattern. Information at this scale tends to be abstract, and the visualisation forms are limited to 2D plots.

At a regional scale, the application of visualisation in participatory frameworks and practices is often focused on urban and environmental planning. Mapping applications (such as GIS, Google Earth) constitute a significant presentation form, which is sometimes coupled with detailed real-world planning datasets to produce 3D visualisation. Virtual simulations in urban planning at this scale are used to evaluate land-use typologies, transportation investments and environmental policies. For example, Ford et al.(2019) projected urbanisation maps showing future populations and land-use scenarios for Greater London to respond to climate change risks. Barredo et al. (2003) simulated the future land-use scenarios coupled with Dublin's social-economic systems through cellular automata.

In environmental planning, scope exists to combine realistic and abstract objects to give adequate ecological data linked to user evaluation or decision-making (Hehl-Lange, 2001; Jern & Nilsson, 2002; Williams et al., 2009). For example, using online social media and national census data, Brindley et al. (2019) found a positive link between the cleanliness of green space and one’s health.

The most frequent application of visualisation in participatory studies is conducted at a local or site scale, particularly in the field of landscape architecture and architecture. The presentation formats take various forms, including simple exposure to images, web-based information systems, 3D visualisations, and other advanced immersive tools. At this scale, visualisation in the establishment and evaluation of scenarios becomes the critical point. Studies in the landscape discipline have investigated public responses to different scenarios about preference (Lovett et al., 2015; Orland et al., 2001; Tress & Tress, 2003; Wissen Hayek et al., 2008). There are discussions concerning the effect of detail and realism on virtual environments, including Lange (2001), Lokka et al.(2019), Orland (1994) and Slater et al. (2009).

Applications of visualisation in architecture projects range from collaborations in design proposals and user behaviour simulation to construction and management (Portman et al., 2015). While little has been discussed concerning visualisation in the construction and management of landscape projects (e.g., Downes & Lange (2015)), there are several applications in the discipline of architecture. For example, Bouchlaghem et al. (2005) developed a visualisation and communication environment (VISCON) system to facilitate designers and construction teams in understanding design details related to implementation, and Yabuki et al. (2010), some years ago, combined AR devices to enhance safety awareness at high-level construction sites.

Across the three disciplines, however, the application of visualisation media in participatory planning has typically concentrated on one level of scale at a time, with a priority at the local or site level. A multi-scalar approach permitting stakeholders to contextualise themselves in a larger picture and downscale to local action is still lacking (Orland, 1992; Oteros-Rozas et al., 2015;

Pettit et al., 2012; Shaw et al., 2009). In addition, many evaluation studies of visualisations have primarily concentrated on a particular point in time during the development course: i.e., during the design and decision-making process. Evaluation of the effectiveness of visualisation tools at the inventory, implementation, and post-occupancy stages have been largely neglected.

2.3 Stakeholder perception of visualisation media

2.3.1 Perception theory related to visualisation and virtual environment

Zube et al. (1982) categorised human response to the environment and visualisation media into four dimensions: cognition, affection, behaviour, and physiology. Cognition relates to knowledge and learning outcomes; affection links with feelings, attitudes, and emotions; behaviour concerns the observable behavioural change of the viewer; and physiology is linked to the viewer's biological or physical effects. This thesis looks into the cognition, affection, and behaviour effects, which reflect a gradually evolving process from basic-level awareness to affection and action (Farley & Stasson, 2003; Oliver, 1999; Sheppard, 2005). Although cognition usually occurs first, these dimensions can occur in parallel or as an iterative process (Berlyne, 1967).

2.3.1.1 Cognition

Cognition refers to the mediational processes that occur between stimulus and response. Visualisation is linked to information processing through attribution pointing, information contextualisation, scenario building, and connecting reality to the cognitive concepts (Wissen Hayek et al., 2008). Many scholars have linked visualisation tools with increased awareness of planning and design. For example, Al-Kodmany (1999) identified the effectiveness of free-hand sketches, web-based GIS, and photo-manipulation in contextualisation, problem identification,

and consensus-building for a community planning project. Salter et al. (2009) noted that participants enhanced their understanding of planning and design due to the flexibility to explore proposed changes using the interactive 3D GIS-based CommunityViz platform.

Visualisation tools, however, have sometimes been blamed for creating barriers to understanding (Brabham, 2009; MacEachren & Kraak, 2001), particularly for those with limited access to computer technologies and the internet, such as rural communities (Bell et al., 2004), minority groups (Fox & Livingston, 2007), and the elderly (Fox & Madden, 2006). Thus, to make technology more accessible to the general public, "coupling between analogue tools and digital visualisation" and "combining on-line and off-line participatory events" have been recommended (Al-kodmany, 2002; Gill et al., 2013; Ryo, 2019).

Cognition derives from both short-term memory and long-term retention. Evaluation of participants' cognition has often been conducted immediately after exposure to a visual stimulus using either self-assessments (Paar, 2006; Pettit et al., 2011; Sheppard, 2005) or objective tests (Bruns & Chamberlain, 2019; Cubukcu & Nasar, 2005). Although these effectively determine the potential of different visualisation tools, they fail to take into account the changes in memory and belief over the longitudinal course (Bishop et al., 2013; Schroth et al., 2015b). Longitudinal research can provide a way to look back at past events and collect data on the influence those events had over time (Elliott et al., 2008).

2.3.1.2 Affection

Studies have investigated participants' feelings and attitudes towards virtual environments, such as safety, well-being, enjoyment, and happiness, using either quantitative or qualitative approaches

(Calogiuri et al., 2018; Kyttä et al., 2013; Mears et al., 2019; Rixon & Burn, 2008). Chon and Shafer (2009), for example, explored participants' responses towards a virtual tour of an urban greenway trail from five affective categories: maintenance, distinctiveness, naturalness, pleasantness, and arousal. Moghimi et al. (2016) examined the public's emotional effects through a three-dimensional model (valence, arousal, and dominance) with varied degrees.

Another body of work focuses on participants' preferences for different planning scenarios generated by visualisation media (Han & Peng, 2019; Smith et al., 2012; Steinitz et al., 2003). For instance, Dockerty et al. (2005, 2006) investigated stakeholders' responses to different land-use scenarios affected by climate change and local policy, using landscape rendering software such as Visual Nature Studio (VNS). Lange et al. (2008) generated four 3D scenarios for green space development in Switzerland: "Agriculture," "Recreation," "Nature conservation," and "Wind turbines," comparing them to the present situation.

A small number of studies concentrate on participants' preferences for visualisation media. Bishop et al. (2001) observed that people make different choices when provided with dynamic visualisations rather than static ones. Appleton and Lovett (2005) found that with computer-based models the landscapes were "easier to imagine" than with static photographs. In a laboratory setting, Gill et al. (2013) showed that plans and interactive eye-level walk-throughs were the most commonly utilised visualisation media types. Yet how stakeholders respond to state-of-the-art visualisation techniques such as AR and VR remains largely underexplored.

2.3.1.3 Behaviour

Compared to evaluation studies on cognition and preference, less research focuses on the behavioural effects of visualisation tools (Sheppard, 2005). Behaviour refers to a systematic and observable manner that provides visual, tactile, kinaesthetic, and vestibular changes to enhance connection with the environment (Ruddle et al., 2011; Waller et al., 2004).

Since most human sensory input is visual, understanding visual interaction with the environment is a primary research concern. As early as the 1960s in *The View from the Road*, Appleyard et al. (1964) mapped humans' visual cues on the highway based on researcher observation to identify landmarks and elements of attractions in the city. While observational methods are subjective and are interconnected with observers, recent developments in eye-gaze tracking software can objectively detail what people have looked at, for how long, and how their visual focus moved from one place to another (Dupont et al., 2016; Kiefer et al., 2017; Noland et al., 2017; Piga et al., 2011).

Tactile feedback is the use of touch to communicate with participants. With haptic feedback from the virtual environment, participants performed spatial tasks better, such as memory retention (Jacob et al., 2012) and sense of direction (Teather et al., 2010). Kinaesthetic responses focus on body movement within the virtual environment. According to Roupé et al. (2014), body movement permits a more natural and user-friendly way to interact with the virtual environment. Using algorithms, recent studies have been able to estimate human movement in virtual environments. Turner and Penn (2002) investigated different pedestrian movements by altering parameters such

as destination selection, fields of view, and steps taken between decision points through agent-based modelling.

Knowledge regarding behavioural responses to visualisation has mainly focused on participant actions during their exposure to visual stimuli. Fewer empirical studies, however, have investigated participants' behavioural changes after exposure to visualisation. Orland (1992) proposed that visualisations could be used to inspire people to take action after being presented with potential consequences. This point is reported by Sheppard et al. (2005), whose participants reported increased motivation to react to climate change. In a participatory workshop concerning ecological rehabilitation, Schroth et al. (2015) identified changes in political operation and policymaking two years after governmental involvement with visualisation media. However, they admitted that compounding factors other than visualisation techniques might play a role in participants' behavioural changes in the long term.

2.3.2 Factors affecting stakeholder perception of visualisation media and virtual environments

Many factors influence stakeholder responses to visual features of the environment, and this thesis focuses on two: stakeholder characteristics and properties of visualisation media. Stakeholder characteristics refer to demographic factors (i.e., age, gender, education level, planning expertise, and ethnic groups) and stakeholder categories (the group the stakeholder belongs to). The attributes of the visualisation environment consider the presentation format and the feature of the visualisation environment.

2.3.2.1 Demographic factors

Age plays a role in participants' perceptions of visualisation media and the virtual environment. It is generally believed that the elderly have more difficulty with visualisation and perceiving it than the younger generation (Jansen et al., 2010; Moffat et al., 2001; Schroth et al., 2015). Gender differences affect perceptions of virtual environments (Arthur et al., 1997; Stamps, 1999); it is argued that males and females use different visual cues to carry out spatial navigation tasks (Sandstrom et al., 1998). Additionally, gender variations were observed in the correlation patterns between rotation tasks and other neuropsychological measures (Parsons et al., 2004).

Participant perceptions of visualisation tools are affected by their education level (Petrosillo et al., 2007). A superiority in spatial perception has been found among more highly educated participants compared to those less educated (Hidayetoglu et al., 2010; Paes et al., 2017). Similarly, Petrosillo et al. (2007) found that tourists' awareness of a protected area is positively associated with their education level. Cross-cultural differences play a role in the perception of virtual environments (Čeněk & Čeněk, 2015; Phillips, 2019; Segall et al., 1990). As Čeněk & Čeněk (2015) pointed out, Westerners tend to focus on salient objects while East-Asians perceive the world in an overall perspective.

Significant differences have been found between how laypeople and experts perceive urban and rural environments with the help of eye-tracking devices (Dupont et al., 2015; Pihel et al., 2015). However, Stamps (1999) argued that distinctions between people with varied planning expertise are more evident in perceiving high-style architectural design than in other natural or ordinary environments. Apart from the experts and laypeople, how other stakeholder groups with varied

interests (such as government officials and journalists) interact with the perceived environment has not been examined in detail.

2.3.2.2 Features of virtual environments and visualisation media

Bishop and Lange (2005) pointed out six features of virtual environments: immersion, interactivity, intensity (realism), intelligence, illustration, and intuition, of which the first three are considered the most important (Lange et al., 2008; Lovett et al., 2015). It is generally accepted that display devices with varied forms of immersion could affect stakeholder perception. For example, Raja et al. (2004) found that participants were most efficient in viewing datasets and performing tasks in a fully immersive environment compared to other conditions. Similarly, Alshaer et al. (2017) pointed out that a higher degree of immersion could help participants reach better performance. Yet, concerns exist about misperceptions of scale in visualisations, as demonstrated by Watzek and Ellsworth (1994) and Willis et al. (2009).

Consensus has been achieved that the greater the realism (level of detail and accuracy), the more similar the responses will be to real-life (Bishop & Rohrmann, 2003). This is consistent with Slater et al. (2009), who found that visual realism induces greater participant presence in immersive virtual environments. Despite these benefits, Appleton and Lovett (2005) argued that a high level of realism may prove distracting. A similar finding by Lokka et al. (2019) showed that participants' memory of route learning was better in a mixed virtual environment than in an abstract or a realistic environment. A further drawback of too much realism concerns ethical issues, such as immoral actions and the virtual representation of real people (Sheppard, 2001; Slater et al., 2020).

Interactivity is generally positively linked to stakeholder perception of the virtual environment. Guillory and Sundar (2014) showed that in designing website interfaces for organisations, higher levels of interactivity enhance individuals' perceptions of an organisation's reputation. Appleton and Lovett (2005) concluded that landscapes are easier to imagine using computer-generated models than 2D images. Schroth (2010) highlighted that interactivity in 3D visualisation allows participants a better understanding of landscape scenarios, which further contributes to the consensus in the decision-making process.

Visualisation media with varied attributes affect how planning is communicated, which in turn affects stakeholder perception. Conventional visualisation formats such as 2D mapping, technical reports, and static 3D visualisation have been considered insufficient for non-experts to comprehend and interact with meaningfully (Al-Kodmany, 2000; Lowe, 2003). Real-time techniques that complement conventional photo-textured visualisation media have proved to be more popular among stakeholders (Appleton & Lovett, 2005). In a laboratory setting, Gill et al. (2013) showed that plans and interactive eye-level walk-throughs were the most commonly utilised visualisation media types.

However, this does not mean visualisation media with interactivity, immersion, and realism will replace conventional planning representations. Al-Kodmany (2002) and Gill et al. (2013) proposed that traditional media and computer-based technologies can complement each other to cater to individual needs and enhance understanding. In addition, although several studies have evaluated how the public responded to conventional technologies, how more novel visualisation techniques, such as AR and VR, can be tailored for stakeholder engagement remain largely underexplored.

2.4 Summary

Chapter 2 traces the development of stakeholder participation in different disciplinary and planning contexts, and argues that a systematic understanding of stakeholder participation in China is still lacking. It reviews different typologies used for stakeholder analysis and evaluates their relative advantages and drawbacks, which relates to analytical methods in this thesis. Further, the chapter introduces the evolution of visualisation media for planning communication. Reviewing the application of visualisation media in research and practice points out that a multi-scale perspective of visualisation for participatory planning practices is lacking. Particularly, examining visualisation effectiveness has primarily focused on the design and decision-making stage; application in the inventory and implementation stage is largely neglected.

Moreover, the chapter examines theories and evidence from research and practices, detailing the public response to the virtual environments and visualisation media and notes that stakeholder responses have been primarily focused on cognition and affection; little is known about behavioural effects. Studies on stakeholder responses to visualisations have tended to focus on a short period; participant feedback in the longitudinal planning process is not discussed in detail. Finally, the influences of stakeholder characteristics and visualisation attributes on public perception of virtual environments are outlined. It is argued that the effects of varied stakeholder characteristics on the perception of advanced visualisation media have been largely neglected.

Chapter 3 - Stakeholder participation and visualisation in the Chinese urban planning system

This chapter reviews the Chinese administrative divisions and urban planning system, laying out the structural framework for this thesis. It then looks at the historical evolution of stakeholder participation in Chinese planning process, with a particular focus on the contemporary planning since 2007. A document analysis was conducted based on laws, regulations, and rules enacted at different scales in the Pearl River Delta, which seeks to understand the operation and effectiveness of stakeholder participation (RQ1) and visualisation (RQ2) in the statutory planning process.

3.1 Chinese administrative divisions and the urban planning system

3.1.1 Administrative divisions of China and the Pearl River Delta

The administrative divisions of China consist of four "de jure" planning levels, including provincial (provinces, autonomous regions, municipalities, and special administrative regions), prefectural (prefecture-level cities, autonomous prefectures, prefectures and leagues), county (districts, counties, county-level cities), and township (towns, subdistricts, townships, ethnic townships, sum and ethnic sum) level (CPGPRC, 2005). A fifth level, called basic-level autonomy, including community and village committees, functions as the fundamental local authority with limited political power. As of December 2019, the People's Republic of China administers 34 provincial-level regions, 333 prefecture-level divisions, 2,846 county-level divisions, and 38755 township-level administrations (MCAPRC, 2020). The detailed divisions are illustrated in Table 3-1 below.

Guangdong province is located in the southernmost part of China. The Pearl River Delta (PRD) refers to the nine prefecture-level cities within Guangdong province (see Figure 3-1 and Table 3-2). Guangzhou is the provincial capital and a sub-provincial city. Shenzhen is a sub-provincial city and is regarded as the first special economic zone in China. The other seven cities, Dongguan, Foshan, Huizhou, Jiangmen, Zhuhai, Zhongshan and Zhaoqing, serve as prefectural-level cities. Hongkong and Macau are special administrative regions (SARs) and are excluded from this thesis since they differ from the mainland in planning systems.

Table 3-1 Administrative divisions of the PRC as of December 2019

Source: adapted from MCAPRC (2020)

Provincial Level	Prefectural Level	County Level	Township Level
(23) Province (5) Autonomous region (4) Municipalities	(293) Prefectural level city (7) Prefecture (30) Autonomous prefecture (3) Leagues	(1323) County (965) District (387) County-level city (117) Autonomous counties (49) Banners (3) Autonomous banners (1) Forestry district (1) Special district	(21116) Town (8519) Subdistrict (8101) Township (966) Ethnic township (153) Sum (1) Ethnic sum
(2) SARs	Hongkong	(3) Region	(18) District
	Macau	(1) Municipality	(7) Parish
(1) Taiwan	/	/	/

Figure 3-1 Location of the city networks of the Pearl River Delta
Source from: HKTDC (2018)

Guangzhou is a prefecture-level city with 11 county-level districts, of which Liwan, Yuexiu, Tianhe and Haizhu are the city's core and most popular among tourists. At the township level, Guangzhou has 140 subdistricts and 34 towns. Examples include the Shamian, Duobao, and Changhua subdistricts within the Liwan District, with further local organisations such as communities and villages. Towns and villages are located in the peri-urban and rural areas, whereas subdistricts and communities are situated in the built-up areas.

Case studies for this research are based in Guangzhou, after a careful evaluation of site accessibility, social impact and stakeholder diversity at different planning levels in the PRD. Therefore, the division of the City of Guangzhou and its higher administrative levels are referred to, to frame the structure of planning levels. Figure 3-2 shows a hierarchical administrative level including national, provincial, city, district, subdistrict (town), and community (village) levels.

Table 3-2 Administrative divisions of 9 cities and 2 SARs in the PRD region

Source from: Department of Civil Affairs of Guangdong Province (2018)

Prefectural Level	County Level	Township Level	Basic-Level Autonomy
Dongguan (DG)		(32) Town	(350) Village (242) Community
Foshan (FS)	(5)District	(12) Subdistrict (21) Town	(327) Village (453) Community
Guangzhou (GZ)	(11) District	(140) Subdistrict (34) Town	(1144) Village (1568) Community
Huizhou (HZ)	(2) District (3) County	(22) Subdistrict (48) Town (1) Township	(1043) Village (227) Community
Jiangmen (JM)	(3) District (4) County-level city	(12) Subdistrict (61) Town	(1050) Village (274) Community
Shenzhen (SZ)	(9) District	(56) Subdistrict (4) Town	(810) Community
Zhuhai (ZH)	(3) District	(10) Subdistrict (15) Town	(122) Village (201) Community
Zhaoqing (ZQ)	(3) District (1) County-level city (4) County	(16) Subdistrict (91) Town (1) Ethnic township	(1255) Village (296) Community
Zhongshan (ZS)		(6) Subdistrict (18) Town	(150) Village (127) Community
Hongkong (HK)	(3) Region	(18) District	
Macau （MC）	(1) Municipality	(7) Parish	

Note: The cities are arranged in alphabetical order (SARs including Hongkong and Macau are listed in the end, not included in analysis due to differences in planning system)

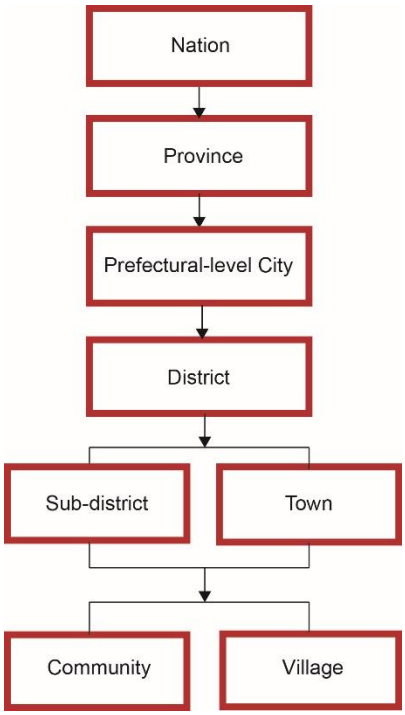


Figure 3-2 Administrative divisions of Guangzhou

3.1.2 The urban planning system in China

The urban planning system of a country generally reflects the social-economic and political environment in which it operates (Gar-on Yeh & Wu, 1999). Before the reform and opening-up (1978), planning in China had been characterised by a lack of planning legislation. Urban planning as territorial planning had a weak position compared to sectoral-based industrial planning. Since the 1980s, efforts have been made to expand the planning scope into a regional scale and specify land development intensity on a micro-scale. In 2008, the *Urban and Rural Planning Law of China* (URPL) marked the evolution from a two-tier system (the master plan and the detailed plan) towards a multi-layer system (Gar-on Yeh & Wu, 1999; Zhao, 2015).

The five statutory plans in this new planning system range from abstract to concrete and from scheme to operation (Curien & Thornely, 2014). These include national urban hierarchical planning, provincial urban hierarchical planning, city planning, town planning, township planning, and village planning (see Figure 3-3). Planning process is divided into four stages, formulation, modification, implementation, and supervision.

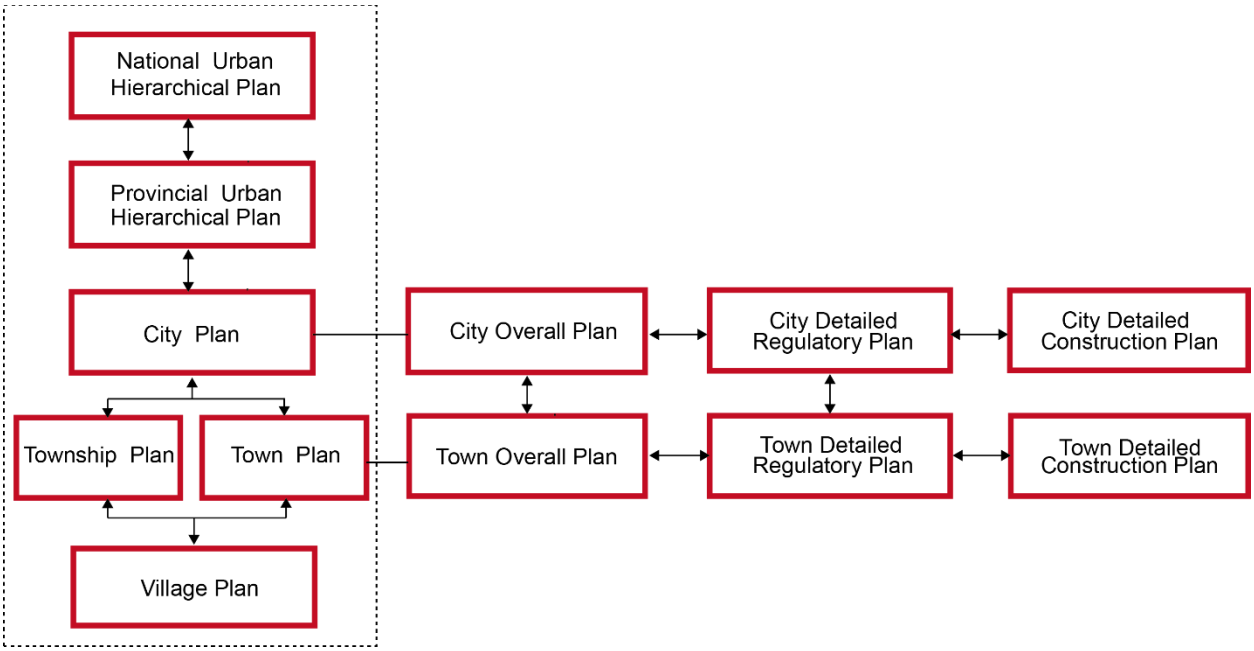


Figure 3-3 Statutory urban planning system in China
Adapted from the Urban and Rural Planning Law of China (2008)

A national urban hierarchical plan serves as guidance for the formulation of a provincial urban hierarchical plan and a city overall plan (URPL, Article 12). **A provincial urban hierarchical plan** includes the spatial layout of cities and towns, the layout of major infrastructures, and the areas that require strict control to preserve the ecological environment and resources (URPL, Article 13). A **city or town plan** is further divided into two parts: an overall plan and a detailed plan. **An overall plan** establishes long-term strategic guidelines (i.e., 20 years), such as the layout of the city or town, functional zones, land use, comprehensive traffic system, regions where

construction is prohibited or restricted, or regions where construction is appropriate, and other types of special items (URPL, Article 17).

A **detailed plan** consists of a detailed regulatory plan and a detailed construction plan (NSPRC, 2008). A **detailed regulatory plan** is used to regulate the land use, intensity, and spatial environment of the construction land in line with the specifications of the city and town overall planning. The **detailed construction plan** goes a step further, guiding the design and construction of important buildings and engineering facilities. In a large or medium-sized city, a topic-related plan and a district plan are often included in the actual operation of urban development. The contents of these two plans are not legally required in the URPL but decided by local governments (Chen & Thwaites, 2018).

During the planning formulation and modification period, planning at the lower level need to comply with the principles defined by the upper planning level. The relevant administrative level is responsible for formulating its urban planning documents, which need to be examined and approved by its higher administrative levels to enter into force (Curien & Thornely, 2014). For instance, the detailed plan should follow the principles defined by the overall plan, which must comply with the urban hierarchical plan that governs it. Where a revision is needed at a particular planning level, it must be approved by the administrative government one level higher. When the modification of planning at a lower level, e.g., a detailed regulatory plan, violates a principle defined by an upper planning level, e.g., an overall plan, the upper level must first introduce a planning change (Article 48, URPL).

The "**one note and two permits**" mechanism is used in the planning implementation stage. If the land is state-owned, the developing units need to apply for **a site selection note**. However, this is not needed for construction projects other than those mentioned above (Article 36, URPL). Then, the developing unit must apply for a **land use planning permit** from the next higher government authority to ensure that the scope of the area within which construction is permitted is in line with the detailed regulatory plan (Article 37, URPL). For the construction of buildings, structures, roads, pipelines and other projects in an area covered by the plan of a city or town, the developing unit or individual must apply for a **building permit**. A **permit for rural construction,** on the other hand, is introduced for the construction of rural public facilities and public welfare undertakings in villages and townships. Construction can only begin if a **building permit** or **permit for rural construction** is granted. Planning supervision is conducted throughout the process.

3.2 Laws and regulations for stakeholder participation in Chinese urban planning

3.2.1 Historical evolution of stakeholder participation in Chinese urban planning

Urban planning in China has a long history. As early as the imperial era, the planning and construction of ancient capital cities like Xi'an, Nanjing, and Beijing were an expression of the social order and hierarchy. In the Republic of China era in the early twentieth century, planning was influenced by Western planning theories (Gar-on Yeh & Wu, 1999). The thesis looks at urban planning since the establishment of the socialist system in the People's Republic of China in 1949. During this period, stakeholder participation in Chinese urban planning can be broadly categorised into three phases: First phase: 1949-1978 — Planning dominated by the central government; Second phase: 1979-2006 — Awareness-raising of stakeholder participation; Third phase: 2007 to

the present — from “Tokenism” (symbolic participation) to “Collaboration”. These are explained in the following sections.

First phase: 1949-1978 — Planning dominated by the central government

Upon the establishment of the People’s Republic of China in 1949, the central government urgently needed the post-war backward economy to recover. Urban planning strategies at this stage were primarily shaped by the centrally planned system for socialist development and influenced by political movements (Chen, 2015; Yeh et al., 2011). Building upon the Soviet model, Chairman Mao Tse Tung suggested achieving socialism by combining agriculture and industry in the countryside, developing self-sufficient communes and eradicating the *Three Great Contradictions*. As a result, in the subsequent First Five-Year Plan (1949-1954), urban planning was subservient to industrialization and production (Gar-on Yeh & Wu, 1999). Priorities were given to site selection for industrial and military modernisation projects with the aid of Soviet experts involved in the training of inexperienced Chinese planners (Chen, 2015). Urban forms at this time featured state-owned work units (*danwei*), grand avenues, and outsized civic squares (Xie & Costa, 1991). Planning was centrally dominated, with no room for the general public to participate in planning affairs.

The Soviet model encountered issues due to the discrepancy between Chinese and Soviet contexts. Because of diplomatic problems, the Soviet experts withdrew their aid in the 1950s. To make things worse, the following turbulent period characterised by the *Great Leap Forward* (1958-1959), the *Readjustment of policies* (1961-1965) and the *Cultural Revolution* (1966-1976) toppled production and construction, slowing the development of the whole country. Urban planning was

blamed for the failure of the *Great Leap Forward* in the National Economic Planning Meeting and postponed for three years. During the *Cultural Revolution* (1966-1976), China's urbanisation was severely stagnant. Following the campaign of *Educated Urban Youth Going and Working in the Countryside and Mountain Areas*, planning bureaus were closed and planners were sent to the countryside for agriculture development (Gar-on Yeh & Wu, 1999).

Second phase: 1979 – 2006 — Awareness-raising of stakeholder participation

The 1978 reform and opening-up policy saw a great shift from a planned economy to a market economy in China. The increasing demand for communitarianism, civil society and democracy called for more public participation in decision-making processes formerly dominated by the central government. The *1990 City Planning Law* (abolished in 2008) was a milestone as it was the first legal document to present a comprehensive urban planning system in China, in which stakeholder participation was legally ensured. Article 10 stipulated, "All units and individuals should abide by the city planning, and have the right to report and sue any violations of the city planning"; Article 28 stated that "Urban plans should be announced to the public after they are approved" (*City Planning Law of the People's Republic of China*, 1990). Nevertheless, this law did not specify procedural norms for operation in participation, such as the scope of participation, participatory methods or supervisory bodies (Hao, 2007). The public was not involved in the planning and decision-making process but was limited to being informed or supporting the planning implementation.

To improve the standardization and scientificity of planning, the 1991 *Measures for Formulating City Planning (MFCP)* was formulated to guide the planning of municipalities, cities and towns,

based upon the *1990 City Planning Law*. It stipulated that "in formulating a plan for a city, comparisons of various proposals, and economic and technical demonstration should be carried out, and opinions of the related departments and residents should be widely solicited" (Article 9). However, similar to the *1990 City Planning Law*, *1991 MFCP* gave no detailed guidance on stakeholder participation (*Measures for Formulating City Planning*, 1991).

This point was addressed in the revised MFCP in 2005, where the operation of stakeholder participation was stated more clearly. Article 16 stipulated, "before submitting the city overall plan, the municipal government should fully solicit public opinion and implement it according to law. In the formulation of detailed planning, the opinions of units and the public involved in the planning should be fully met through publicity and consultation. The results of the adoption of relevant opinions should be announced" (MoC, 2006).

Third phase: 2007 to the present — from "Tokenism" to "Collaboration"

The 2008 *Urban and Rural Planning Law of the People's Republic of China* (URPL) is a milestone as it makes it clear that the people's governments at all levels and their relevant urban and rural planning authorities should publicise information across four stages of the planning process: formulation, revision, implementation and supervision (*Urban and Rural Planning Law of People's Republic of China*, 2008). To supplement the 2008 URPL, the Ministry of Housing and Urban-Rural Construction of the People's Republic of China (MHURC) enacted *Regulations on Publicity of Urban and Rural Planning* in 2013 and gave detailed guidance on the operation of stakeholder participation for different forms of planning (MHURC, 2013). Since then, technical rules and guidance specifying the methods of stakeholder participation have been applied at

different planning levels (Kai, 2011). However, hardly any systematic studies focus on stakeholder participation in contemporary Chinese planning. Thus, the following section conducts a document analysis of these laws and regulations concerning stakeholder participation and visualisation.

3.2.2 Document analysis of stakeholder participation and visualisation in planning documents

The document analysis aims to understand two questions: how stakeholder participation and visualisation work in the statutory planning process, and how effective they are (Research Question 1 and 2, hereafter RQ1 and RQ2). It mainly looks into laws, regulations, and rules enacted since 2007, focusing on two critical planning stages: formulation and implementation (as mentioned in Section 3.1.2, the planning modification shares a similar procedure with the formulation period for stakeholder participation). The document analysis builds on the framework analysis method developed by Ritchie et al. (2013), which was set for large-scale policy research. It proposes a five-step structure to systematically simplify and visualise data, including familiarisation, identification of the thematic framework, indexing, charting, and mapping and interpretation (Gale et al., 2013).

3.2.2.1 Methods

Familiarization

In this step, an overall picture was obtained through scrutinising policy documents related to stakeholder participation and visualisation in Chinese planning. A total of 21 documents covering three administrative levels were referenced (see Appendix B for the full list of document details), including LV1 Law and ordinances enacted by the State Council and Ministry of Urban and Rural Planning (n= 3); LV2 provincial by-laws and regulations promulgated by the people's government

of Guangdong Province and relevant provincial departments in charge of urban and rural planning (n= 4); LV3 city-level regulations and rules formulated by the people's government and relevant departments in charge of urban and rural planning in the PRD (n= 14).

It was noted that local regulations and public participation requirements vary between cities with unlevelled economic, development, and geographical locations within the PRD region. For example, while Guangzhou, Shenzhen, and Zhuhai have their planning ordinances, less developed cities such as Huizhou and Dongguan only have enacted local management regulations, which have less legal power compared with the planning ordinances. This point is also reflected in the different levels of diversity and detail on stakeholder participation in the provisions.

Identifying a thematic framework

Building on Ritchie et al.(2013), NVivo 12.0 was used to conduct the framework analysis, to store policy documents and conduct a systematic review. Following an inductive approach, texts and codes related to stakeholder participation and visualisation media were highlighted. They were grouped into three themes at planning formulation and implementation stage respectively: participation phase, participatory tools and visualisation media.

Indexing

Each policy was re-read and re-coded in line with the three thematic categories for further analysis. Figure 3-4 shows the indexing process using the example of *Measure on Planning Publicity and Enclosure* (referred to as N2 in Appendix B). Themes and codes used across each phase were represented by the numerical number on the left column to describe (1) planning formulation; and (2) planning implementation. Within each stage, themes of participation ranged from 1 to 3 to

show (1) participation phase, (2) participation tools, and (3) visualization media. The policy was presented in the middle column, with texts related to the themes highlighted. The corresponding coding stripes were presented in the right column.

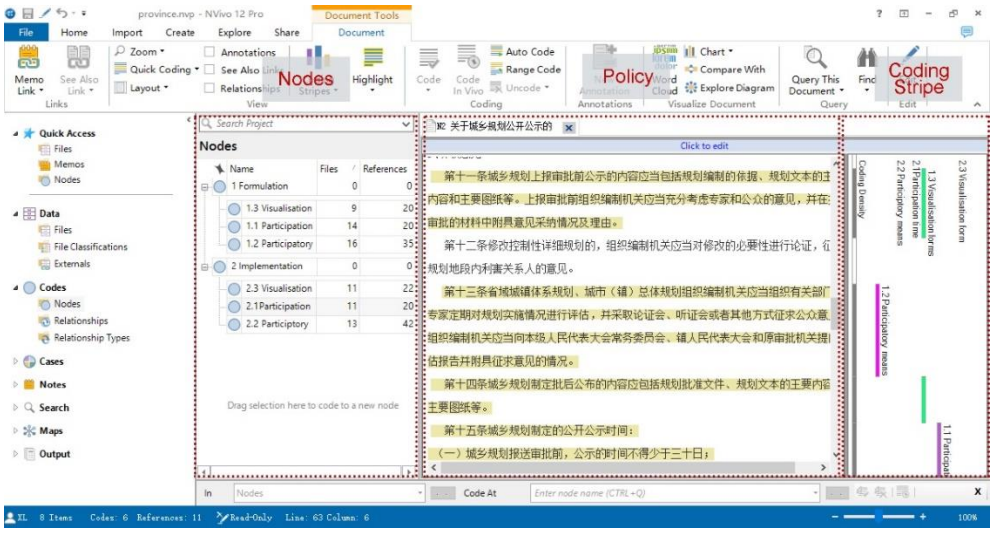


Figure 3-4 Indexing process in NVivo 12 using the Measure on publicity in urban planning (2013) Left: list of indices; middle: policy; right: coding

Charting

Data was extracted from their original context and rearranged according to the themes, using sources defined in the earlier steps. Table 3-3 shows the example of the charting process of *Measure on Planning Publicity and Enclosure* (N2) during the planning formulation period. Data was recorded in accordance with the relevant source (Article, name of planning document) (see Appendix B for the names of planning documents). Following this structure, all the urban and rural planning laws, ordinances, regulations, and rules were sorted and charted. They were then combined into a larger chart, with rows (cases), columns (codes), and "cells" of summarised data.

Mapping and interpretation

The final stage analysed data that was listed in the charts, which could help to "define concepts, map range and nature of phenomena, create typologies, find associations, provide explanations, and develop strategies" (Ritchie & Spencer, 2002, p.186). The participation phase, participation tools and visualization media across different development periods were mapped following the Figure 3-3 Statutory urban planning system in China. The similarities and differences between each planning level were compared in the results section.

Table 3-3 The charting process of Measure on Planning Publicity and Enclosure (N2)

	Statutory planning	Participation phase	Participatory tools	Visualisation media
National	National urban hierarchical planning			
Provincial	Provincial urban hierarchical planning	before approval, >30 days (A9, N2); after approval, (A9, N2)	demonstration (A13,N2); hearing (A13, N2)	text (A11, N2); 2D image (A11, N2)
City/Town	City/Town overall planning	before approval (A9, N2); after approval (A9, N2)	governmental website (A5, N2)*; exhibition hall (A5, N2)* demonstration (A13,N2); hearing (A13, N2)	text (A11, N2); 2D image (A11, N2)
	Detailed regulatory planning	before approval (A9, N2); after approval (A9, N2)	governmental website (A5, N2); exhibition hall (A5, N2); on-site (A5, N2)	text (A11, N2); 2D image (A11, N2)
	Detailed construction Planning	before approval (A9, N2); after approval (A9, N2)	On site (A5, N2); governmental website (A5, N2)	text (A11, N2); 2D image (A11, N2)
Township	Township plan	before approval (A9, N2); after approval (A9, N2)	On site (A5, N2); governmental website (A5, N2)	text (A11, N2); 2D image (A11, N2)
Village	Village plan	before approval (A9, N2); after approval (A9, N2)	On site (A5, N2); governmental website (A5, N2)	text (A11, N2); 2D image (A11, N2)

Note: A refers to Article, and N2 is the abbreviation for the planning document, which could be found in Appendix B.

3.2.2.2 Results

Participation phase in the statutory planning process

Figure 3-5 represents the participation phase of stakeholders in the planning formulation stage. Across the different planning levels, government authorities and commissioned planning institutes oversee the preparation of planning, while the public is only involved in the latter stages. They are consulted when plans have been made and are notified after planning approval. After a plan has been made and sent to the relevant government authority for approval, the public is given 30 days or more to provide feedback. After planning approval, the publicity period and the participatory tools used, vary from city to city, ranging from more than 15 days in presentation of on-site publicity boards in Dongguan (SCPC of Dongguan, 2012), to long-term publicity (i.e., more than one year) on government websites in Guangzhou (HURDB of Guangzhou, 2014; SCPC of Guangdong, 2012).

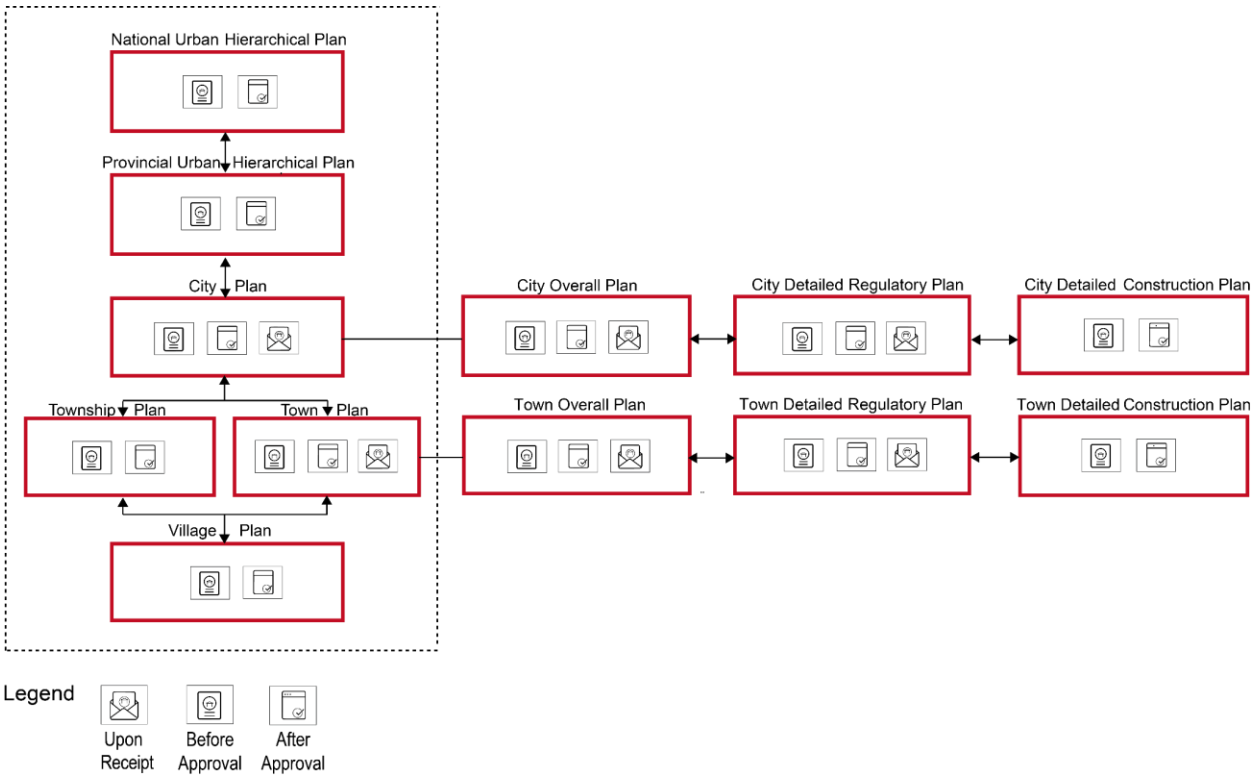


Figure 3-5 Participation phase in the planning formulation stage

Note: the icons were arranged in descending order according to the mentioned frequency.

At the planning implementation stage, the proposed development needs to fit with the land use guidelines stipulated at the higher planning level. Since overall planning at the upper planning levels provide generic guidelines and are hardly reflected in practices. This stage primarily focused on developments implemented through detailed regulatory planning, detailed construction planning, township, and village plan. As shown in Figure 3-6, upon receiving the developers' application for "one note and two permits" (explained in Section 3.1.2), a short notification should be given to the general public.

Before issuing these documents, the stakeholders are consulted for a short period, ranging from 5-20 days e.g. in N2 (MHURC, 2013), P3 (HURDD of Guangdong, 2012), DG1(SCPC of Dongguan, 2012), FS2 (LRUPB of Foshan, 2015), GZ2 (LRUPB of Guangzhou, 2014), JM1 (SCPC of Jiangmen, 2013). After the approval of the "one note and two permits", many cities/areas require that a longer period of time is given for the public to get notified before the project has been implemented and meets the initial planning requirements (LRUPB of Huizhou, 2020; MHURC, 2013; NRB of Jiangmen, 2019; SCPC of Foshan, 2018; SCPC of Jiangmen, 2013).

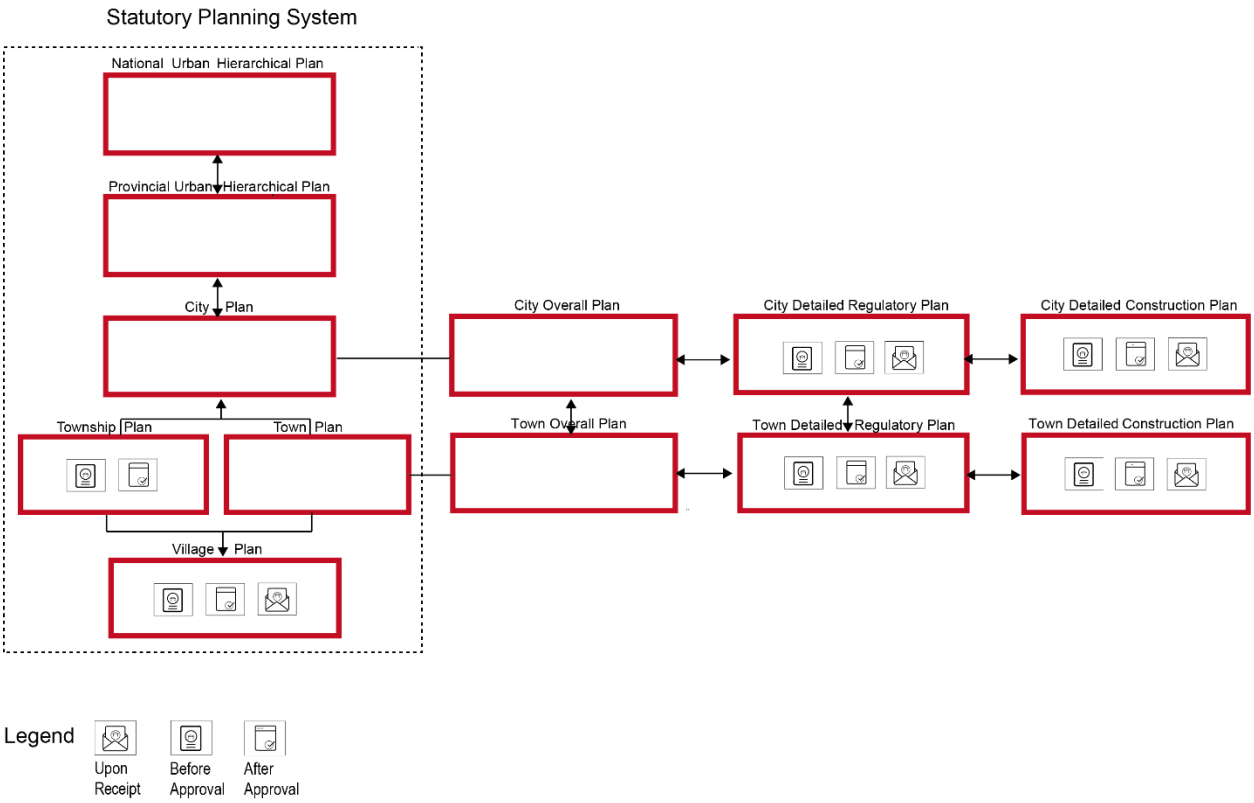


Figure 3-6 Participation phase in the planning implementation stage

Note: the icons were arranged in descending order according to the mentioned frequency.

Participatory tools for statutory planning process

The participatory tools as suggested in the statutory planning process includes: - demonstration, hearing, symposium, government website, on site publicity board, planning exhibition area and the news media. The definitions and role of each tool is explained in Section 1.7. Figure 3-7 shows the participatory tools used in the planning formulation stage. There is generally little means for participation in hierarchical planning at the national level. At this stage, participatory tools include demonstration, hearing, government websites and brochure. At the Guangdong Provincial level, participatory tools include demonstrations and hearings (when necessary), government websites, news media, and planning exhibition area.

Participatory tools get more diverse at the city and town level, where government websites, exhibition halls, and news media are the most popular tools. Stakeholder participation at the township and village level is not specially addressed due to the ownership of land and relatively less developed local condition. Publicity in the public open space of the village or township is most frequently used (LRUPB of Zhaoqing, 2004; SCPC of Guangdong, 2012; SCPC of Guangzhou, 2015; SCPC of Zhaoqing, 2017).

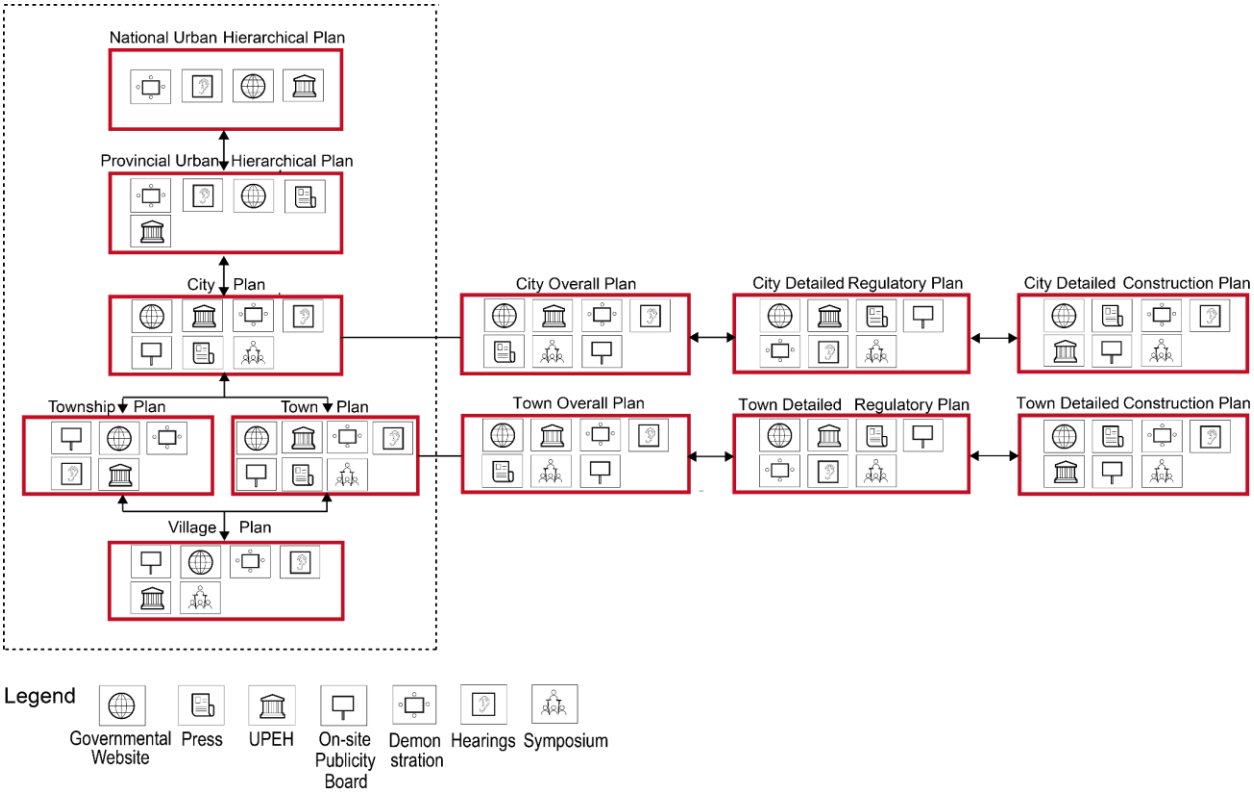


Figure 3-7 Participation tools in the planning formulation stage

Note: the icons of participatory tools were arranged in descend order according to the frequency of being mentioned.

The planning implementation stage is related to areas within cities, towns, townships and villages. At this stage, on-site publicity board, government website, and the village's publicity board in the area's public open space are most often suggested for engaging stakeholders (Figure 3-8) (SCPC of Dongguan, 2012; SCPC of Guangdong, 2012; SCPC of Guangzhou, 2015) .

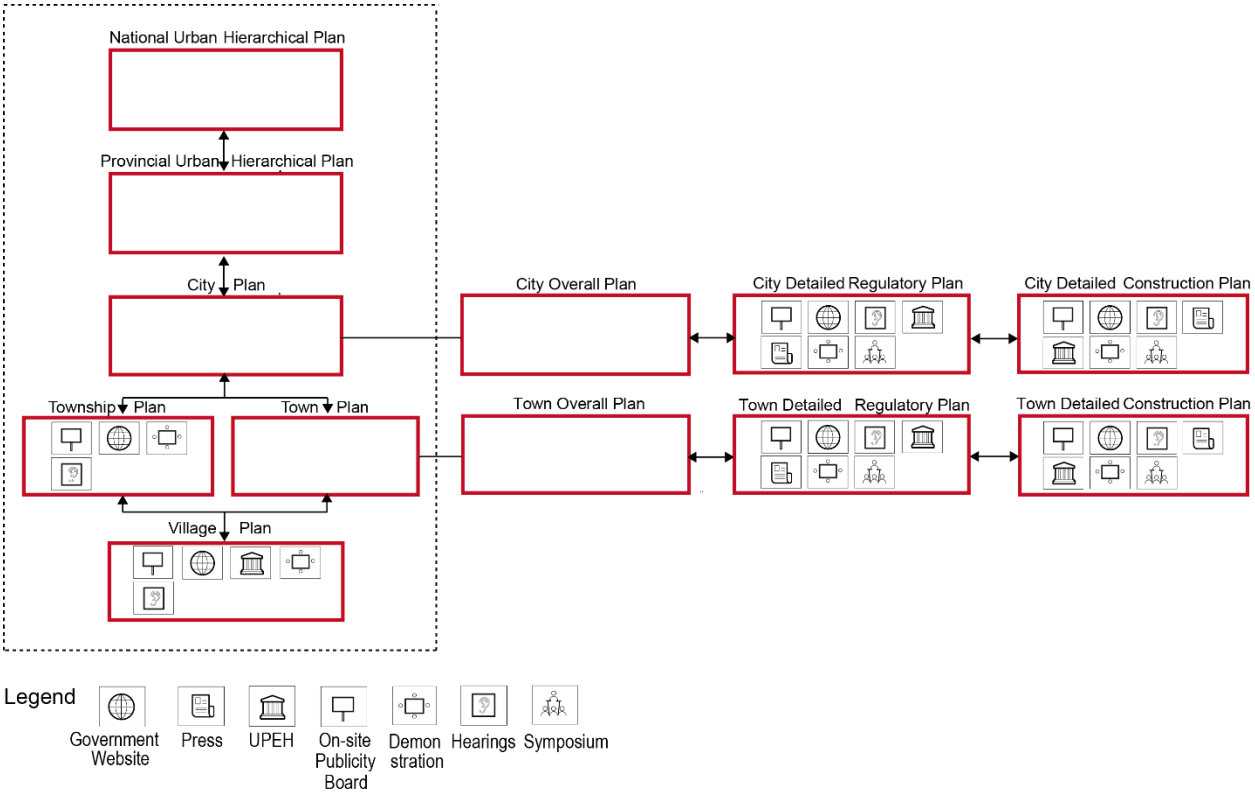


Figure 3-8 Participation tools in the planning implementation stage

Note: the icons of participatory tools were arranged in descending order according to the frequency of being mentioned.

Visualisation media for participation

Visualisation media for information communication in the planning formulation stage is illustrated in Figure 3-9. Visualisation media ranges from an abstract to more concrete levels as the project proceeds into a more detailed phase. Little provisions have specified the visualisation media for national urban hierarchical planning. The publicity information of relevant plan on the internet suggests the visualisation media includes text and 2D maps, which is the same as the requirement of the provincial urban hierarchical plan and overall plan.

In both the planning formulation and implementation stage (Figure 3-9 and Figure 3-10), when it comes to critical projects in the city/town detailed planning, visualisation media would also include 3D perspective images (SCPC of Foshan, 2018). Visualisation media at the township and village

level are not specifically addressed in some cities. It is recommended that they choose the media based on their local situation while following the regulations at the next higher planning level.

In addition to conventional media such as text, 2D maps and 3D rendering, the urban planning exhibition hall is equipped with advanced visualisation media. These include large physical models, multi-channel digital sand table models, video, 4D visualisation, 6D cinema, VR, and AR (Lu et al., 2020). It covers various planning scales ranging from a national perspective to site-scale design (ROGMPG, 2017).

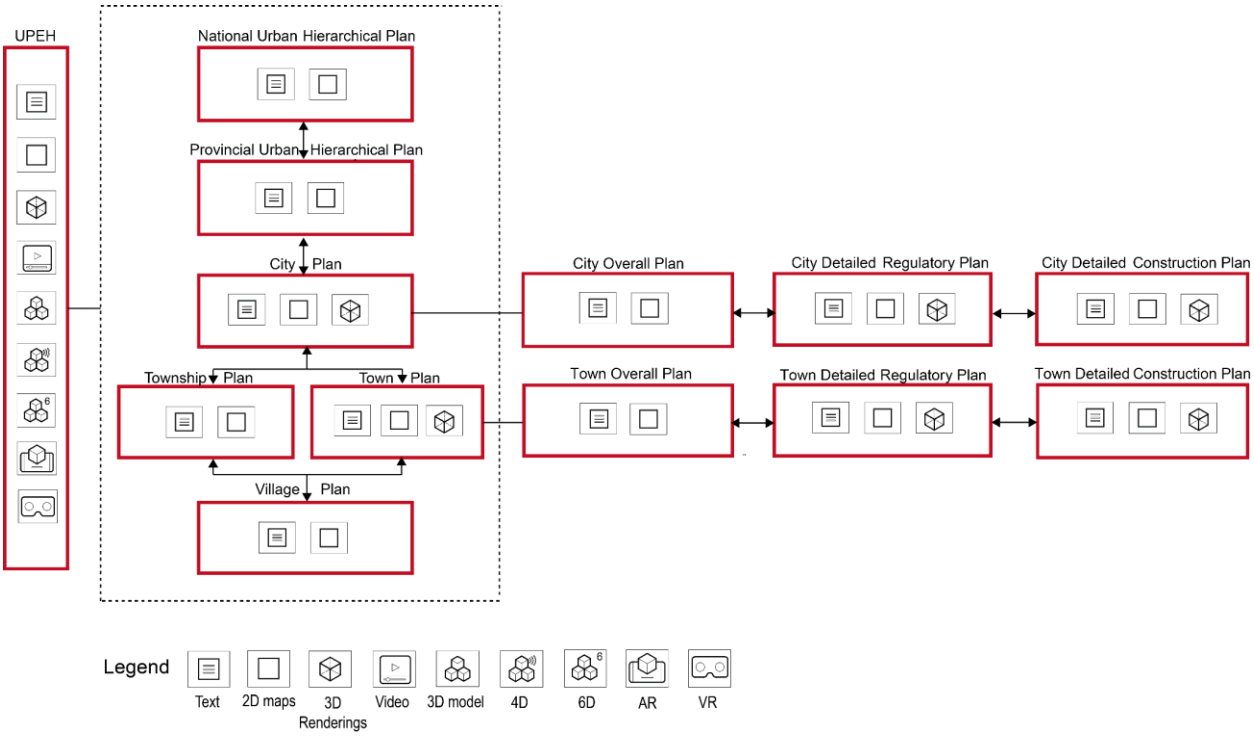


Figure 3-9 Visualisation media for stakeholder participation in the planning formulation stage

Note: the icons of visualisation media were arranged in descending order according to the frequency of being mentioned.

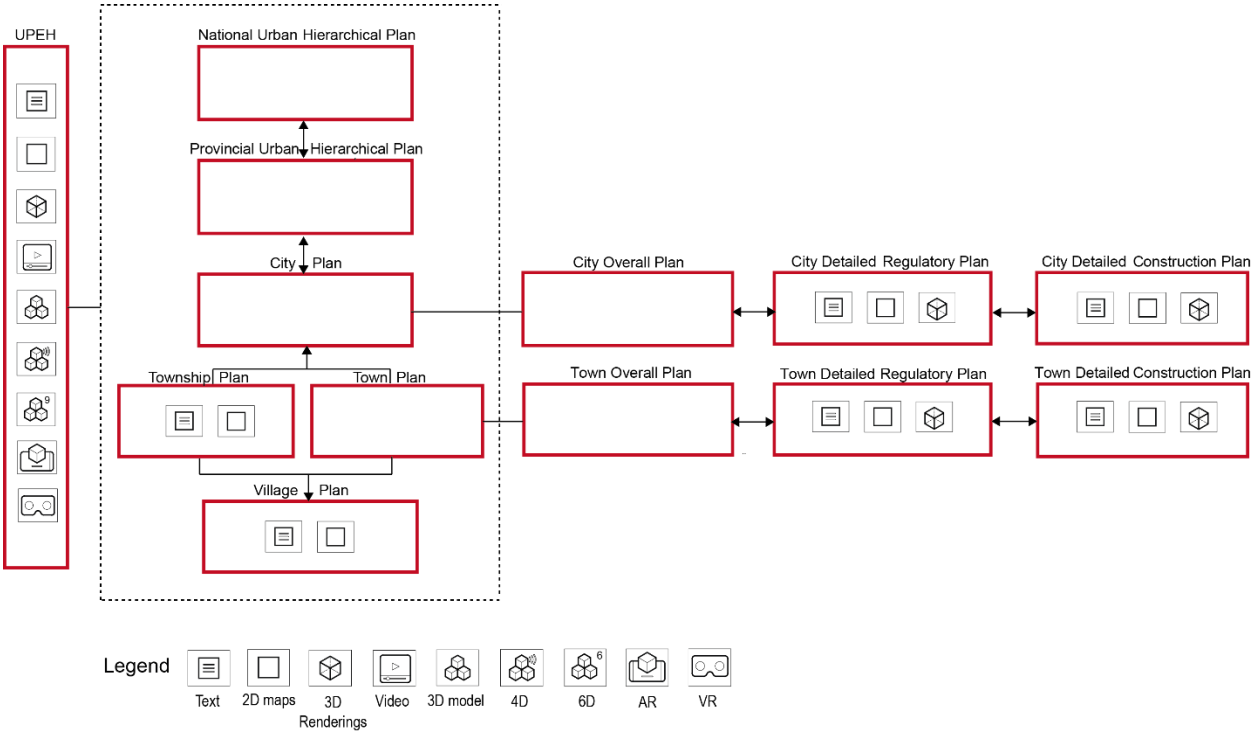


Figure 3-10 Visualisation media for stakeholder participation in the implementation of planning

Note: the icons of visualisation media were arranged in descending order according to the frequency of being mentioned

3.2.2.3 Discussion

Across the phases of planning formulation and implementation, the general public in the PRD is often consulted before the planning approval, and notified after the decision-making with 30 days for providing feedback. As such, the public in Chinese context is still staying at the rung "information" or "consultation" of "Tokenism" levels where they may indeed hear and be heard (Arnstein, 1969, p.217). Under these conditions, however, they have limited opportunities to get their opinions heeded by the decision makers. Wilson et al. (2019) suggested that involvement at the later planning stage provides little room for revision of the plan compared to early engagement, since planning at this stage has already been negotiated between the local government authorities

and developers. This highlights the need to involve stakeholders at the earlier planning stage and throughout the entire planning cycle to reach more meaningful participatory outcomes.

Public hearings, demonstrations, and symposiums are frequently used participatory tools to engage stakeholders when planning is associated with a great social impact or that would seriously affect the image of the area. Nevertheless, these traditional methods have been often criticised for the low accessibility to the general public (Conroy & Evans-Cowley, 2006). The timing and form of venues are often to blame for low participation levels; Due to work, family, and other responsibilities, few people are able to take the time to engage in these activities. This point has been overcome by methods including government websites, planning exhibition halls, on-site publicity board, and the news media. Nevertheless, these tools are primarily intended for one-way information rather than two-way interaction. Participatory tools that allow the general public to be actively and widely involved in the urban planning process are still lacking.

Visualisation media for planning communication are mostly text and 2D mapping. 3D rendering is occasionally used when planning is in a more detailed stage, e.g. regulatory planning and detailed construction planning in Foshan and Guangzhou. As addressed in Section 2.3.2, these conventional tools may fail to be well understood by the lay people due to the lack of interactivity, immersion, and realism. Although the UPEH stands out to be a unique tool that covers multiscale planning information with various state-of-the-art visualisation devices, in the ladder of participation model proposed by Arnstein (1969), it generally sits at the lowest level of the ladder used to inform stakeholders. This further indicates the need to understand the production and utilisation of the UPEH.

3.3 Chapter summary

This chapter reviews the Chinese administrative divisions and urban planning system, laying out the structural framework for this thesis. The administrative levels in the PRD involve provincial, prefecture, county, township, and community/village levels. The statutory planning system includes national hierarchical plan, provincial hierarchical plan, city plan, town plan, township and village plan. City and town plan are further divided into the overall plan and detailed plan. The relationship between the administrative level and statutory planning is analysed in the formulation, modification, and implementation stages of planning.

This chapter then scrutinises the history of stakeholder participation, which becomes a legal part of Chinese urban and rural planning policy in 1995, and specified its operation in the 2008 *Urban and Rural Planning Law*. The analysis of 21 planning documents at different levels suggests that the public is less involved at the earlier stages of planning and design and is often more involved when the draft plan/construction project has already been accomplished and sent for approval. Furthermore, the challenge remains to involve a broader range of stakeholders and pursue two-way interaction in the decision process through advanced visualisation media (Münster et al., 2017). In addition, urban planning exhibition hall is a widely used forum in the context of participatory planning with multi-scale planning information and various state-of-art visualisation tools, which requires further understanding of its effectiveness.

Chapter 4 - Provincial level - The urban planning exhibition hall

This chapter introduces the phenomenon of the UPEHs at the provincial level in the Pearl River Delta (Figure 4-1). The UPEHs serve as museums of urban planning to inform people about the past, present, and future of particular geographical regions. They cover planning information over most of the urban planning system (Figure 4-2). The Guangzhou UPEH is selected as a case study to evaluate the UPEH's role in stakeholder participation and planning communication. Residents or visitors to the UPEH who could potentially affect or be affected by urban planning in Guangzhou are regarded as stakeholders in this research. Through a repeated measures design approach, Section 4.2 investigates whether stakeholders visiting the UPEHs enhance their participation in and knowledge of urban planning in Guangzhou with various visualisation media (RQ1, RQ2). Section 4.3 analyses the visualisation media for landscape communication (RQ2) and how different stakeholders perceive these tools in the Guangzhou UPEH (RQ3).

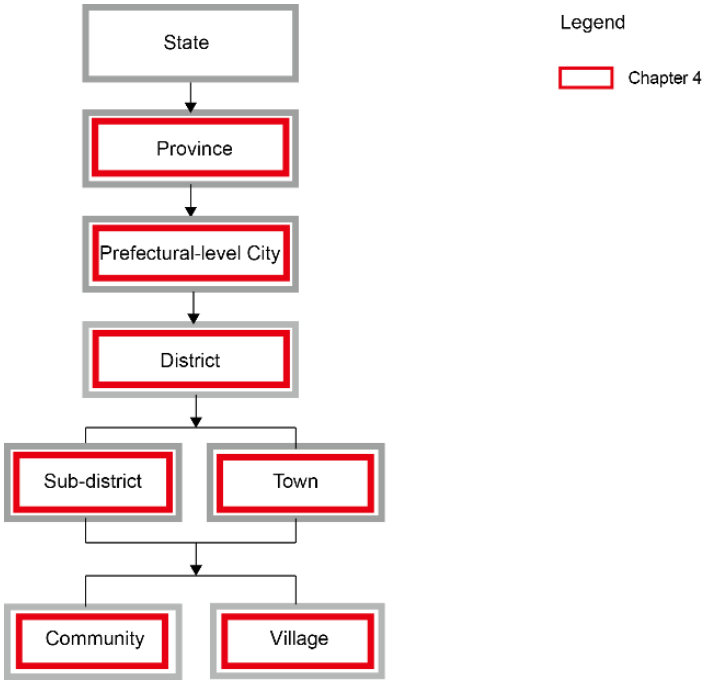


Figure 4-1 Planning scopes of the UPEH

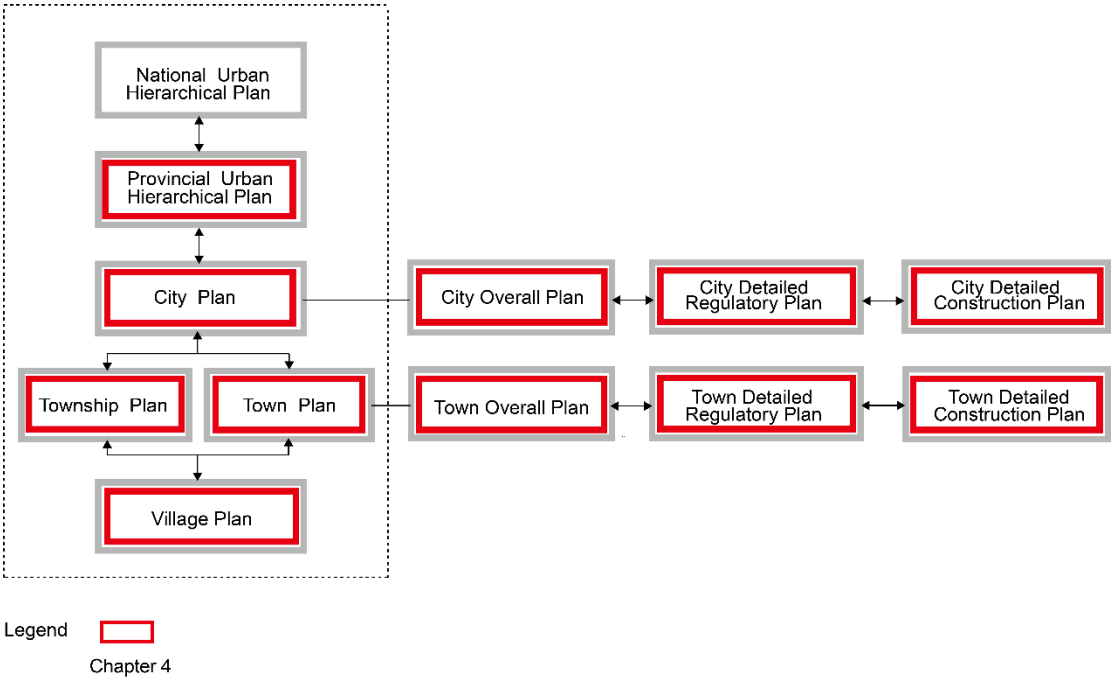


Figure 4-2 Planning information covered by the UPEH

4.1 Urban planning exhibition halls in the Pearl River Delta

4.1.1 Urban planning exhibition hall: Origin and development

Engaging the general public at a higher rung of Arnstein's (1969) ladder of citizen participation remains an important challenge in contemporary planning processes (Tewdwr-Jones et al., 2020). Enhanced stakeholder awareness is necessary for fostering a better understanding of the value of planning and progress (Council of Europe, 2004, 2008). Internationally, the role of planning exhibitions towards increasing civic engagement and communication in urban planning has been highlighted in a series of theories and practices. In which, various forms of past, present, and future urban change have attracted participants through diverse visualisation media.

For example, the "White City" was presented in the 1893 World's Columbia Exposition in Chicago, laying the ground for the City Beautiful Movement; Patrick Geddes (1915) proposed the prototype of the "Outlook Tower" in Edinburgh as an observatory civic laboratory; and then in 1939, the "Futurama" ride was organized at the New York World Fair, depicting a vision of urban life in 2014. Recent examples include "Barcelona in Progress", a permanent exhibition featured in a 1:1000 scale city model in 2004, and Farrell's (2014) concept of the "Urban Room", which is implemented in over 15 cities and towns across the UK (Tewdwr-Jones et al., 2020).

Planning exhibitions worldwide vary due to the differences in funding bodies and planning systems (Tewdwr-Jones et al., 2020). The urban planning exhibition halls (UPEHs) in China are a similar example, which differ from others in terms of their huge number and scale. Since the first UPEH was built in Shanghai in the late 1990s, they have spread over the country at an unprecedented rate, totalling 880 UPEHs by 2017 (see Table 4-1). The UPEH provides a platform to understand the past, present, and future of a specific geographical area through diverse visualisation tools, ranging from 2D maps, models, 3D visualisations, 4D video, VR, and AR (Lu et al., 2020). As stated by the Association of Urban Planning Exhibition (AUPE) (2016), the mission of the UPEH is to enhance planning communication and public participation, while some scholars have seen it rooted more in top down hierarchical power and city branding (de Jong et al., 2018; Fan, 2014; Lai, 2009).

Until now, there has been a considerable gap in knowledge about the UPEH's effectiveness in knowledge dissemination and public involvement, and they have hardly been examined in practice, particularly from a quantitative perspective. Therefore, this chapter seeks to quantify the effectiveness of the UPEH in planning communication and public engagement with a wide range of visualisation media.

Table 4-1 The Urban planning exhibition halls (UPEH) across all levels in China by 2017

Source: Adapted from Chen and Chen (2017)

Number	Administrative division	Total Number	Already Built	To be built	Percentage of UPEHs already built
1	Provincial capital and municipality	31	27	4	87.1%
2	Prefecture	334	224	110	67.1%
3	County, District	2853	542	2311	19.0%
4	Economic development zone and High-tech District (in provincial capitals and municipality)	219	87	132	39.7%

4.1.2 Urban planning exhibition halls in the PRD

There is a total of eight UPEHs in the Pearl River Delta region (see Table 4-2). Using parameters including exhibition size, media richness, social impact, and accessibility, assessed by fieldwork, the Guangzhou UPEH was selected as a focus of this study. It occupies an exhibition area of 30,000 square metres and contains 119 sets of exhibitions over four floors (see Appendix L for exhibition photos). The exhibition content covers a range of topics regarding the past, present, and future of Guangzhou, such as history, geography and culture, future planning, transportation, utilities, and landscape environment (see Figure 4-3).

Table 4-2 UPEHs in the Pearl River Delta and their attributes

City	Name	Year of opening	Floor space (m^2)	Media richness	Social impact	Accessibility
Dongguan	Dongguan Urban Planning Exhibition Hall	2017	15000	***	**	***
Foshan	Foshan Urban Planning Exhibition Hall	2019	20000	***	**	***
Guangzhou	Guangzhou Urban Planning Exhibition Hall	2018	84000	***	***	***
	Nansha Pearl Bay Exhibition Hall	2016	3800	**	*	*
Hongkong	Hongkong City Gallery	2012	3000	*	**	***
Shenzhen	The Museum of Contemporary Art & Planning Exhibition	2020	88185	***	***	**
	Bao'an District Urban Planning Exhibition Hall	2016	5300	**	*	**
Zhuhai	Zhuhai Hengqin Urban Planning Exhibition Hall	2012	22242	**	*	*

Note: "*" to "***" indicates performance in the parameter, verified by the researcher

Figure 4-3 Urban planning exhibition halls in the PRD

Left: Foshan UPEH; Middle: up- Hongkong City Gallery, middle- Nansha Pearl Bay Exhibition Hall, bottom-Dongguan UPEH; Right: Up- Shenzhen Bao'an District Urban Planning Exhibition Hall, middle-Shenzhen Museum of Contemporary Art & Planning Exhibition, bottom-Guangzhou UPEH

4.2 Repeated measures design experiment - Planning communication and stakeholder participation

4.2.1 Research context

Three well received learning theories are behaviourism, cognitivism and constructivism (Ertmer & Newby, 1993). Behaviourism addresses the impact of external stimuli on people's behaviour. Cognitivism focuses on the psychological process occurs at processing of received information and its linkage with one's prior information database. Constructivism proposes that learners actively build their own knowledge and understanding rather than being passive recipients. Falk and Dierking (2016) draw upon the constructivism approach, proposing that learning in a museum is jointly affected by one's personal, physical, and social-cultural environment.

This provides the theoretical grounding for understanding the dynamics of individual's learning and participation in urban planning from their visit in the Guangzhou UPEH (RQ1 and RQ2). This section seeks to explore: (1) Are there differences in the knowledge acquisition and participation level in urban planning before and after stakeholder's visit to the UPEH? And if there are, (2) How do personal, social, and physical factors interact with their changes in knowledge and participation level in the UPEH?

4.2.2 Method

4.2.2.1 Research method

Drawing on Falk and Storksdieck (2005), a repeated measures design approach was adopted to examine whether there are changes in knowledge and participation in urban planning after people spent time in the Guangzhou UPEH. Participant selection was designed to be objective and

representative of the typical visiting groups of the Guangzhou UPEH. One adult from every fifth set of visitors was randomly approached at the UPEH entrance and invited to participate in the experiment. As is shown in Table 4-3, participants were classified into two groups. The experiment group (n=55) received questionnaires before and after their visit and a walking interview during their visit. The control group (n=60) completed a questionnaire before and after their journey without the researcher's presence. The walking interview data will be discussed in Section 4.3, and the primary focus of this experiment is on the data collected before and after visiting.

Table 4-3 Framework of research design

Group.	Before visits	During visits	After visits
Experiment group	Personal info Self-assessment Test questions	Walking interview Record duration of stay in each exhibit	Re-evaluate self-assessment Revise test questions
Control group	Personal Info Self-assessment Test questions	NA	Re-evaluate self-assessment Revise test questions

Building upon Falk and Dirking (2005), participant data regarding personal, physical, and social–cultural dimensions were collected before and after their visits (see Appendix C for the questionnaires). These included age, gender, education level, familiarity with the city, prior knowledge, whether they came alone or with a group, whether they were guided or not, researcher presence, and the total length of their time in the exhibition.

Three types of measurements of knowledge acquisition with varying complexity were then used before the journey: (1) a self-assessment of participant knowledge level based on a Five-Likert

scale, ranging from “minimum or none” to “very high”; (2) a self-evaluation of participation level based on a Five-point Likert scale, referring to non-participation, informed about planning, involved in consultation and collaboration with others, to empowerment (Arnstein, 1969; Luyet et al., 2012); (3) nine single-choice questions based on different facts about urban planning in Guangzhou that were discussed with the local staff to ensure that they covered the key points conveyed by the exhibition; (4) an open-ended question to test participants’ comprehension of different knowledge dimensions of urban planning in Guangzhou; and (5) an open-ended question clarifying why their consider themselves situated at the relevant rung of stakeholder participation.

Upon finishing their journey in the Guangzhou UPEH, the questionnaire was shown again to the participants (see Appendix C). Given the time limitation and possible fatigue for repetitive work, they were asked to re-evaluate their knowledge level and participation level in urban planning, revise their answers for the single-choice questions, supplement their responses to the open-ended questions and explain their perceptions of participation level in urban planning process. Notably, a limitation with this repeated measure design approach is the ‘demand bias’. For the self-reported questions, participants may guess the research aims and state that their knowledge level has increased, which could impact the validity of their answers. Therefore, the research design has adopted different types of questions (self-evaluation, single-choice and open-ended questions) to get a more comprehensive understanding of participants’ perception changes.

4.2.2.2 Data Analysis

The personal, social, and physical factors were calculated through descriptive analysis in SPSS version 25.0. The means of participants’ self-assessment data on their knowledge and participation

level was calculated on a Five-point Likert scale. Single-choice questions were evaluated according to the standard answers with a score of one for a right answer and zero for a wrong answer. Building on Braun and Clarke (2006) and Nowell et al. (2017), the open-ended questions of stakeholder perceptions of their participation level were transcribed and coded in NVivo software using an inductive approach.

Drawing on Falk and Dirking (2005), the open-ended question results were measured by the breadth and depth of the answers. The breadth of responses is defined by the number of conceptual categories proposed by participants (example of measurement criteria and scoring process is listed in Appendices D and E). The scores for breadth of responses range from 0–8, representing the answer out of a total of eight non-overlapping categories in the exhibition, including urban development and layout, future planning, economy and geography, landscape and environment, history and culture, historical preservation of ancient buildings and districts, transportation, and utilities. The depth of responses is classified into six levels based on the level of detail and sophistication in the answers provided within each conceptual category. A score of 0–5 was used to represent the level of detail ranging from none, extremely limited, somewhat limited, generally adequate, good, to excellent. The user data was scrutinised and measured using the aforementioned standard and cross-checked by a research assistant.

To examine the difference between the outcomes prior to and after their visit, as well as the influencing factors on the changes in learning and extent of participation, the normality of participants' scores in different parameters was first measured with the Shapiro-Wilk test (Field, 2013). The dependent variables were not distributed normally; thus, the Wilcoxon Signed Ranks

Test was used to analyse the difference in mean scores and evaluation levels before and after their visit. Ordinal regression was used to examine the effects of different personal, social and physical factors on changes made in their self-assessed knowledge level, participation degree, and single-choice questions. The Analysis of Covariance (ANCOVA) was used to detect the difference between the means of different independent groups for the open-ended questions (Field, 2013).

4.2.3 Results

4.2.3.1 Changes in learning outcomes

During the data collection period from October 2018 to January 2019, there were 115 effective participants involved in the experiment. The personal (age, gender, education level, occupation, and familiarity with the city), social (if they came alone or with a group, if they were guided or not, and researcher presence) and physical (visit length) factors that were hypothesised to influence the outcomes in learning and level of participation are shown in Table 4-4. Prior knowledge, as an additional hypothetical influencing factor, was determined by the participant's score in the knowledge tests (single-choice questions and open-ended questions) before each visit.

Participants' knowledge levels significantly increased in all three tests. The mean score of self-evaluation of knowledge (M=2.91) after visiting was 0.8 points higher than the prior self-evaluation level (M=2.10) ($p<0.001$). The mean score of the single-choice questions was 4.08, and it increased to an average of 5.98 after each visit ($p<0.001$). Concerning the open-ended questions, the scores improved significantly in both depth and breadth dimensions. The average breadth of knowledge was 1.37 out of eight exhibition themes before visiting, and it increased to an average of 2.5 in the post-visit evaluation ($p<0.001$). The mean depth of the participants' knowledge increased from 2.85 to 6 after their visit ($p<0.001$).

Table 4-4 Personal, social, and physical environment of the UPEH

	Factor	Number	Proportion %
gender	male	62	53.9%
	female	53	46.1%
age	18-34	73	63.5%
	35-54	31	27.0%
	55+	11	9.6%
level of education	high school, college and below	18	15.7%
	university	70	60.9%
	master and above	27	23.5%
familiarity with the city	Foreigner and people from SARs	4	3.5%
	Visitors from mainland China excluding Guangzhou	24	20.9%
	local (< 5 years)	23	20.0%
	local (>5 years)	64	55.7%
occupation	government official	8	7.1%
	professionals and students in the built environment fields	16	14.2%
	professionals/students in the media/interior field	13	11.5%
	investor/businessman/policy-related	6	5.3%
	others	70	61.9%
researcher presence	With researcher	55	47.8%
	Without researcher	60	52.2%
come alone or with a group	alone	29	25.4%
	in a group without kids	65	57.0%
	in a group with kids	20	17.5%
with guide or not	with guide whole process	14	12.4%
	with guide periodically	7	6.2%
	without guide	92	81.4%
visiting length	0.13 - 4.5 h	115	100%

Ordinal regression and ANCOVA tests were applied where appropriate to examine the significant associations between personal, social, and physical factors and the changes in knowledge and

participation levels in urban planning. Age, gender, occupation, familiarity with the city, whether they came alone or not, whether they used a guide, and the researcher's presence did not significantly influence participants' knowledge acquisition and the extent of participation. However, prior knowledge, level of education, and the visit length were significant predictors of the changes in specific knowledge tests.

People with high prior knowledge were less likely to increase in knowledge level, with an odds ratio of 0.232 (95% Confidence Interval (CI), 0.108 to 0.499). Wald Chi-Squared test (or Wald test) showed a significant effect of prior knowledge level, $\chi 2(1) = 13.988$, $p < .001$. For the factual knowledge revealed by single-choice questions, participants who answered factual knowledge tests more accurately tended less likely to improve, with an odds ratio of 0.959 (95% CI, 0.930 to 0.989), Wald $\chi 2(1) = 6.986$, $p = 0.008$. In contrast, an increase in time spent visiting the UPEH was positively linked to the likelihood of improvement in single-choice questions, with an odds ratio of 5.640 (95% CI, 2.4 to 13.2), Wald $\chi 2(1) = 15.8$, $p < 0.001$.

Regarding the open-ended questions, there was a significant difference in mean depth of knowledge gain [$F(2,105)=5.892$, $p=0.004$] between the level of education. Post hoc tests using Bonferri's test revealed a significant difference between master's level and above and high school level or lower ($p=0.006$), as well as between university level and master level and above ($p=0.017$). People with a higher level of education degree are more likely to increase their depth of knowledge ($M = 4.58$), compared to those who hold a degree of high school level or below ($M=2.18$) and those who were educated to a university level ($M=2.99$).

4.2.3.2 Changes in level of participation

Statistical analysis showed that stakeholder evaluation of their participation levels in urban planning significantly increased from an average of 1.51 points before visiting (SD=0.842) to 2.05 points after visiting (SD=1.016) ($p<0.001$). This indicates a movement from slightly over "none or minimum participation" towards more than "being informed about planning", yet at a certain distance from the level of consultation.

The qualitative feedback from participants reveals a lack of understanding of the term "stakeholder participation." They frequently inquire, for example, "What exactly is stakeholder participation?" Following clarification, their attitudes can be divided into two categories: positive perceptions and negative feedback. Participants feel a lack of participation due to the absence of participation mechanisms, confidence in their influence power, and professionalism in decision-making. The advocates, on the other hand, believe their knowledge of Guangzhou improved after this visit.

Negative feedback

Lack of engagement channels in the urban planning exhibition hall (UPEH) is one of the most significant reasons (highlighted by Participants A19, A21, A29, A33, A35, and A55) for negative attitudes. For example, both A29 and A35 responded that "The feedback channel in this UPEH is neither clear nor flexible," while A33 and A55 stated that "I hardly saw any opportunities for us to make suggestions." A government official, Participant B57, argued that "The participation here [at the UPEH] is different from what I usually encounter in daily work, where more active feedback is operated", highlighting the distinct nature of stakeholder participation in the UPEH.

Hence, participants offered ideal participatory tools based on prior experience. “An interactive public engagement device such as pressing a small button in front of each row of seats, where people could easily sit while switching between different contents such as transportation, environment, and education” is desired by Participant A51. Similarly, A35 proposed to “vote via self-media or mobile, instead of being passively informed”. B29 remembered “seeing some opportunities for publicity on the government website”.

Another commonly emphasized reason is participants’ lack of influence over decision-making as a result of the unique interaction between civil society and municipal government. For example, Participant A51 asserted, “We don’t have the power to make urban planning suggestions, and even if we could do, they [government authorities] wouldn’t pay any attention.” B24 claimed that “Given the current political climate, we can’t even participate. All my fantasy wishes are very unlikely to be reached.”

Third, participants lacked confidence in their ability to make scientific recommendations. A29, for example, stated that “If one is unfamiliar with Guangzhou’s urban planning, one cannot make good suggestions; without research expertise, one cannot make valid suggestions either.” He admitted, “It is generally government officials and professionals who could participate.” Further to his comments, he believed that “professionals are trained to do this.”

Positive feedback

On the other hand, advocates considered their participation level significantly increased due to enhanced knowledge of Guangzhou. A42 said, “I have a clearer overview of Guangzhou now. I

used to consider planning only related to buildings or roads on the ground, and I just realised that infrastructure below the ground is also a part of planning." B41 argued, "I can feel that Guangzhou's economic, social and political power is getting much stronger."

Participants noticed that UPEH has already provided areas with potential for stakeholder engagement. As stipulated by A34, "Exhibits that are not in the main circulation route show how governments pursue 'transparent and open planning' through public participation, which is in the underground floor of the UPEH (Figure 4-4a). This shows that the government is optimistic about engaging stakeholder participation, so why not provide more space for receiving feedbacks in urban planning?" B37 indicated that "learning that government authorities have provided a set of platforms for public participation, such as the Guangzhou Urban Planning Committee, and the villagers' voting for the *beautiful countryside campaign* (Figure 4-4b)."

(a) (b)

Figure 4-4 Exhibits about public participation in the Guangzhou UPEH
(a) Exhibits showing transparent on-going planning for public feedback
(b) Guangzhou government provides a few platforms for feedback

4.2.4 Discussion

This research is one of the first attempts that comprehensively look at urban planning exhibition halls in China and their effectiveness in stakeholder participation and planning communication. Stakeholders to the Guangzhou UPEH improved significantly in terms of knowledge acquisition in urban planning in both the self-evaluation and objective tests. This supports the official function of UPEH regarding planning communication, as stated by CAUP (2007); The result is in line with the finding of Fan (2014) through the post-visit rating of visitors to the UPEHs in Shanghai, Nanjing, Hangzhou and Chongqing, where visitors were generally satisfied with the function of information dissemination.

Similar to the results of Falk and Dirking (2005), demographic variables such as age, gender, familiarity with the city, and occupation did not significantly influence knowledge increase. Social factors, including the nature of the visiting group, the presence of a tourist guide, and the researcher bias did not play a significant role either. These findings suggest that the UPEH, with varied visualisation media, could serve as a platform for inclusive learning for the general public.

People with less prior knowledge were found to be more likely to improve significantly in both the self-assessment and factual questions. Those with a higher education level were linked to an increased possibility of enhancing the depth of complicated knowledge. This suggests that people with varied knowledge backgrounds can visit the UPEH and improve in different knowledge dimensions. The results also revealed that people were more likely to gain more factual knowledge after a lengthier visit. This implies that the UPEH should focus on retaining visitor attention in order to enhance learning effects. Possible ideas for exhibition design could include using exhibits

with larger dimensions, presentations through multi-media devices and presenting information that focuses on the city and site scale (Lu et al., 2020).

Despite a significant increase in participation level after visiting the UPEH, it remains at a relatively low level (M=2.05), falling just slightly over the 'information' rung, with certain distances from the "consultation", "collaboration" or "collaboration" , as stipulated by the ladder of citizen participation (Arnstein, 1969). In addition, none of the social, personal, and physical factors investigated in this study played a role in the change of participation level in urban planning. Post-interviews with participants and fieldwork across different UPEHs in the PRD suggest causes from both curator design and public's lack of awareness. These suggest that there is room for improvement in public awareness and in the setup of the UPEHs for greater public engagement.

4.2.5 Conclusion

This experiment seeks to understand the role of the UPEH in planning communication and stakeholder participation by using the example of the Guangzhou UPEH. A repeated measures design approach was adopted to test the knowledge acquisition and level of involvement before and after participants' visits. The study has demonstrated the effectiveness of the UPEHs for raising public awareness of urban planning after their visits. It also shows the effectiveness of visualisation media in the UPEH in enhancing stakeholder's cognition. The personal, social, and physical factors generally did not prove to have a significant effect on changes in self-assessment and objective tests. However, participants' prior knowledge, education level, and visit length were found to influence changes in specific dimensions of knowledge.

The findings call for the UPEHs in mainland China to provide more opportunities for effective stakeholder involvement. The initiatives at the Hongkong City Gallery may serve as an example for offering the public a higher level of interaction with urban matters, rather than just being informed about them. This includes providing a wide range of materials, consultations, seminars and workshops to make planning contents more accessible (HongKong City Gallery, n.d.) .

Admittedly, this section primarily focused on whether individuals acquired a new or enhanced understanding of the facts and/or concepts regarding urban planning shortly after spending time within the Guangzhou UPEH. Memory restoration consists of short-term, long-term and working memory (Cowan, 2008). Short-term memory may be accompanied by temporal decay and chunk capacity limits. Therefore, future research could examine public perception of urban planning over a longer period. Furthermore, increased learning in the museum could have a wide range of potential outcomes, including gaining skills, developing interests, improving attitudes and emotions, and changing behaviours (Hooper-Greenhill, 1991). Future research could examine other dimensions of learning outcomes to get a holistic understanding of the effectiveness of the UPEHs.

4.3 Media preference experiment

4.3.1 Research context and variable classification

As addressed in Section 4.1, the UPEH uses a range of visualisation tools to inform the public about the past, present, and future development of a specific geographical area. However, few discussions have been carried out on the use of digital technology and stakeholder perception in the UPEHs. By using the walking interview data from the repeated measures design approach (see

Table 4-3), this section first explains the representation of the landscape to the public in a wider social context (RQ2) and the effects of the physical display and its content on the stakeholders' perception towards landscape visualisation tools (RQ3). By content, I mean the landscape themes and the planning scales of these visualisations. In terms of the physical aspects, I focus on the size and media type of exhibit.

First, on-site observation and off-site verification is used to determine if an exhibit belongs to the landscape discipline. They were then coded based on the theme, scale, media, and size of exhibits. The China Subject Categories Scheme by the State Council of China was used to classify the themes of landscape (Ministry of Housing and Urban-Rural Development, 2011). These include *historical landscape conservation*, *landscape theory*, *landscape design*, *landscape planning and ecological restoration*, *vegetation and planting design* and *landscape technology*.

Based on aligned administrative divisions within the Guangzhou Municipality (see Figure 3-2), I focus on the site, district, and city scale. In line with the classification criteria in Figure 2-2, static and dynamic tools are used to classify visualisation media, which include 2D images, 3D physical models, and multimedia approaches. The size of a landscape representation is determined by its exhibition area (see Table 4-5-a for a detailed description of the classification system).

Table 4-5 Classification system of landscape exhibitions of the Guangzhou UPEH

	A		B	
Variable	Classification	Detailed description of classification	Count	Percent
Theme	Historical landscape convention	Protect and manage historical landscape values and important ecological services	22	47.8%
	Landscape theory	Applied theory of origin, evolution, development and formation of landscape	0	0%
	Landscape design	Small and medium sized outdoor recreational space design	4	8.7%
	Landscape planning and ecological restoration	Multi-scale landscape protection and implementation across biosphere, land, region, town and community	18	39.1%
	Vegetation and planting design	Vegetation and conservation for green space, tourism, sanatoriums, etc.	2	4.3%
	Landscape technology	Technical principles, material production, maintenance and management	0	0%
Scale	Site	Detailed planning and design of a landscape development	8	17.4%
	District	Landscape planning and design within 135 subdistricts and 35 towns in Guangzhou	20	43.5%
	City	Landscape planning and design at the municipal level of Guangzhou	18	39.1%
Media	2D image	Plan, satellite image, section, perspective, bird-eye view, photo, etc.	10	21.7%
	3D physical model	Models made from sand, polyvinyl chloride, wood, acrylic, resin, etc.	14	30.4%
	Multi- media	A combination of different content-such as text, audio, images, animations, video and interactive content	22	47.8%
Size	Small	Exhibition area < 5 m^2	10	21.7%
	Medium	Exhibition area > 5 m^2 and < 20 m^2	23	50.0%
	Large	Exhibition area > 20 m^2	13	28.3%

4.3.2 Method

4.3.2.1 Data collection and analysis

Following museum visitor studies (Falk & Adelman, 2003), two parameters were used to evaluate the attractiveness of landscape exhibits: “attracting power” (the frequency of a visitor stopping to look at an exhibit) and “holding power” (duration that the visitor stays at an exhibit). These were combined with participants’ comments, behaviours, and interactions for causal interpretations. As stated in Section 4.2, each participant was asked to lead the way and explore different exhibits at his/her own pace. The frequency of visits and duration of the visit in each exhibit and related comments or interactions with companions were recorded on a pre-designed sheet. A total of 55 participants were recruited and their responses to landscape exhibits were analysed (Lu et al., 2020).

IBM SPSS Statistics 25.0 was used for analysing the spatio-temporal data. Due to the skewness of independent variables, Log transformations [Log (time of duration) and Log (frequency of visits)] were used to ensure that data fulfilled normality checks. To begin, a one-way ANOVA was used to determine the main effect of each factor on the outcomes (Field, 2013). If only one factor demonstrated to be statistical significance, the researcher reported this and concluded the investigation. If two or more variables were significant, line graphs were plotted to demonstrate whether these variables had interaction effects. Finally, verbal and behavioural records during visits were transcribed and analysed through NVIVO 12 to illustrate the findings (Lu et al., 2020).

4.3.3 Results

4.3.3.1 Landscape visualisation in the Guangzhou UPEH

There are 46 landscape-related exhibits in the Guangzhou UPEH, with most themes related to *historical landscape convention* (47.8%) (Figure 4-5a) and *landscape planning and ecological restoration* (39.1%) (Figure 4-5b). Few exhibits address *landscape design* (8.7%) (Figure 4-5c) and *vegetation and planting design* (4.3%) (Figure 4-5d). The themes *landscape technology* and

landscape theory were not mentioned (Lu et al., 2020). In terms of the scale of these themes, visualisations at the district level have the most significant number of exhibits (43.5%), followed by city scale (39.1%), with site scale having the fewest of all (17.4%). Medium-sized exhibits dominate concerning size, accounting for half of the landscape visualisations, while small and large exhibits constitute roughly one-quarter (see Table 4-5b for the detailed proportion of each variable).

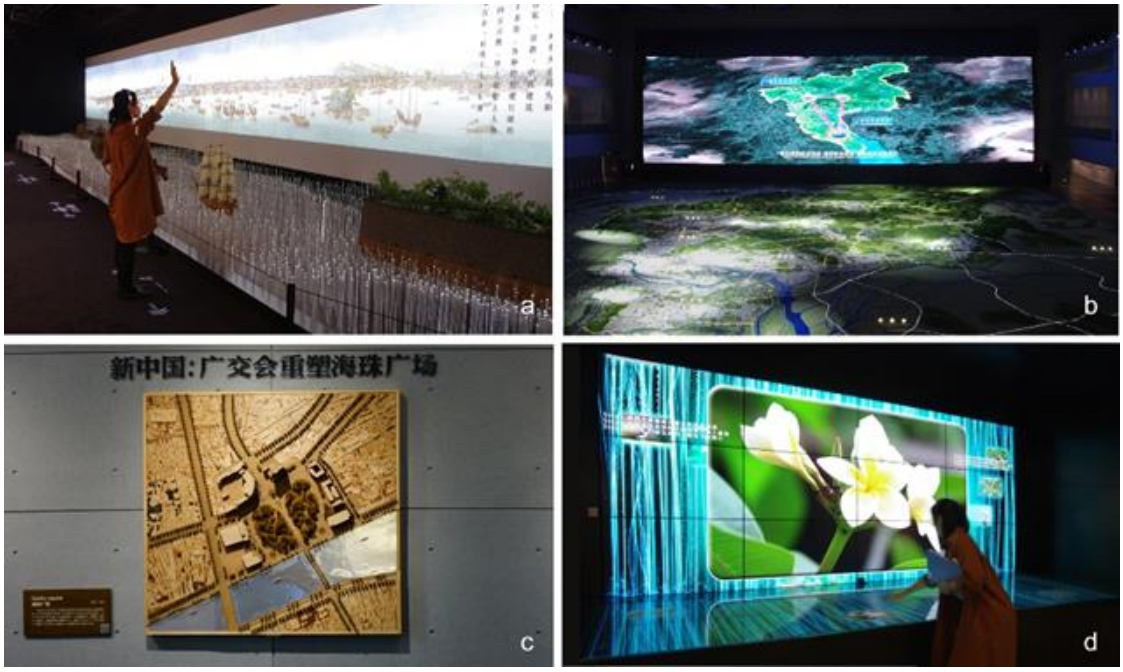


Figure 4-5 Examples of landscape visualisations by themes

(a) Historical landscape convention; (b) Landscape planning and ecological restoration; (c) Landscape design; (d) Vegetation and planting design

Most exhibits rely heavily on 2D images as their primary source of landscape information. They are rarely used exclusively; however, Figure 4-6a shows an example where native species and their flowering seasons are illustrated through static representations. Rather, 2D images are frequently used as supplementary information in conjunction with other advanced tools. 3D physical models

are also widely adopted (30.4%). The demonstration of the Lychee Lake Park in Guangzhou is one example (Figure 4-6b).

Current topics such as *historical landscape convention* and *landscape planning and ecological restoration* are often presented using a variety of multi-media methods (47.8%). These include: (1) visualisation using imaging technology, such as holographic cinema, 4D and 6D animations; (2) advanced interactive tools combined with static and moving images, such as touch screen and dynamic stepping device; and (3) new emerging high-tech applications including VR, AR and immersive games. For instance, Figure 4-6c shows the interaction between a visitor with the video of the rural landscape. Figure 4-6d illustrates the panorama view of the city's new axis through a VR game. As a result, visitors can immerse themselves in and interact actively with a large variety of exhibits.

Figure 4-6 Examples of landscape visualisations by media

(a) 2D image; (b) 3D physical model; multi-media such as (c) UAV driving and (d) Immersive games

4.3.3.2 Stakeholder perception of landscape visualisation

Among the four variables of visualisation including theme, scale, media, and size, size (p = 0.001) had a significant influence on people's frequency of visits. Large visualisation tools (M = 34.38) were more likely to attract visitors than small (M = 20.3) or medium (M = 15.6) visualisations (see Figure 4-7a). However, there were no significant effects of landscape themes, scale, and media on generating "wow" effects.

Scale (p = 0.023), media (p = 0.007) and size (p = 0.000) showed statistically significant effects on their time spent in each visualisation. Post-hoc analysis using Steffe's F test reveals that exhibits at the city scale (M = 5026s) attracted people for a longer time than the district scale (M = 1874s) (Figure 4-7b) (Field, 2013). However, district scale does not differ significantly from the site scale. Figure 4-7c demonstrates that people engage 62 minutes longer on average with multimedia devices than 3D physical models. Regarding size, large visualisations (M = 7155s) differ significantly from either of the other groups (Figure 4-7d) (Lu et al., 2020).

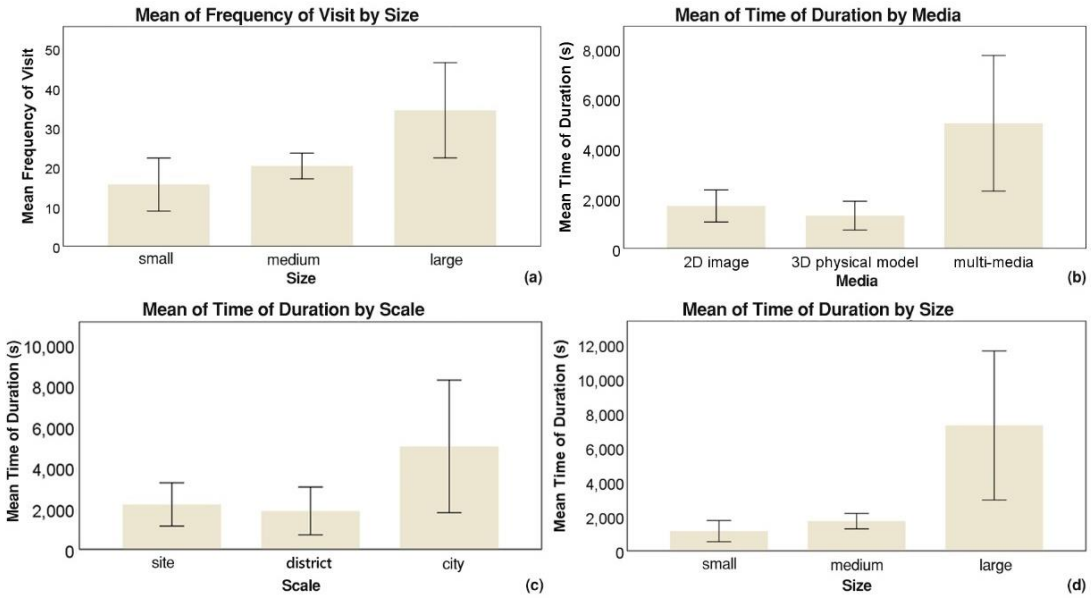
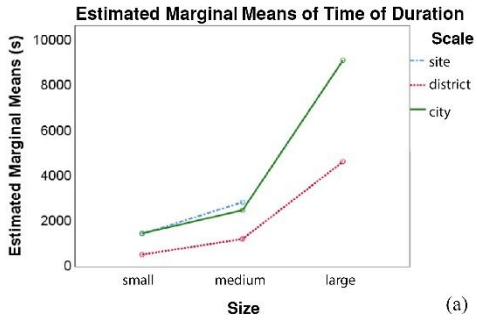


Figure 4-7 95% CI error bars of the effects of size, media, scale on the time of visit.

(a) Mean frequency of visit by size; (b) Mean duration of stay by scale; (c) Mean duration of stay by media; (d) Mean duration of stay by size

The effects of scale, media, and size on duration were then investigated using interaction plots. Figure 4-8a shows that size and scale do not interact as the lines are reasonably parallel. At each planning scale, participants spend more time as the size increases. Interaction effects occur between scale and media (Figure 4-9a). Duration of visit increases as the planning scale expands for both 3D physical models and 2D images. However, the holding power of multimedia is greatest at the city scale and lowest at the district scale. Figure 4-10a displays an apparent interaction effect between size and media. 2D images perform best at medium sizes, whereas other media groups have their best performance at large sizes (Lu et al., 2020).

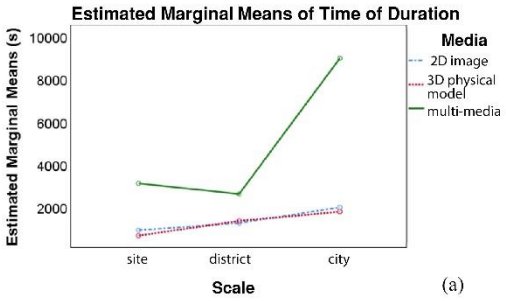


Size * Scale Crosstabulation

		Scale			
		site	district	city	Total
Size	small	3	2	5	10
	medium	5	13	5	23
	large	0	5	8	13
Total		8	20	18	46

(b)

Figure 4-8 Interaction effects between size and scale on time spent on exhibits
(a) Means of time by size and scale; (b) Size * scale crosstabulation

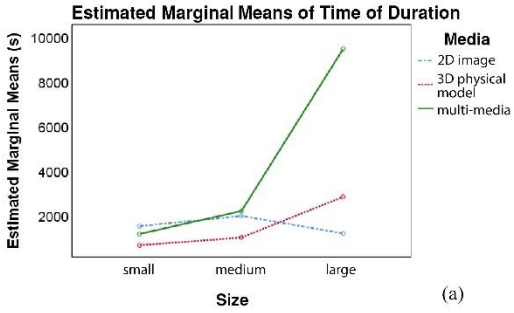


Scale * Media Crosstabulation

		Media			
		2D image	3D physical model	multi-media	Total
Scale	site	1	2	5	8
	district	2	9	9	20
	city	7	3	8	18
Total		10	14	22	46

(b)

Figure 4-9 Interaction effects between scale and media on time spent on exhibits
(a) Means of time by scale and media; (b) Scale * media crosstabulation



(a)

Size * Media Crosstabulation

		Media			
		2D image	3D physical model	multi-media	Total
Size	small	4	3	3	10
	medium	5	8	10	23
	large	1	3	9	13
Total		10	14	22	46

(b)

Figure 4-10 Interaction effects between scale and media on time spent on exhibits
(a) Means of time by size and media; (b) Size * media crosstabulation

4.2.4 Discussion

Historical landscape conservation and *landscape planning and ecological restoration* are popular themes in the Guangzhou UPEH. The more theoretical and technical aspects have been largely neglected. The reason might be that presenting knowledge in these aspects to non-specialists in an accessible way is difficult. In addition, with the purpose of city branding (Denton, 2013; Fan, 2014), the priority for exhibition design will be to present its overall historical and urban development, rather than focusing on theoretical and technological contents (Lu et al., 2020).

Large-size landscape visualisations were found to be significantly more effective at attracting and maintaining attention. This corresponds to participants' responses. When confronted with the big model (occupy an area of 1600m^2) (Figure 4-5b), participants expressed interest in its size, as evidenced by behaviours such as photo- and video-taking. People spent more time at exhibits at the city scale than those at other planning scales. As expressed by participants, "the depth and breadth of information contained at this scale", and "the unique bird's-eye view perspective on the city that it [Figure 4-5b] provides" were two of the reasons for this.

Multimedia approaches demonstrated a better "holding power" compared to the exclusive use of 2D images or 3D physical models. This confirms Gill et al.'s (2013) findings that traditional media and computer-based technology can complement each other. Additionally, newer interactive visualisation techniques also show potential for public engagement. This is emphasized by a participant, who expressed her feeling after watching a video with sound, movement and water effects in the 6D cinema that depicts the future landscape in 2050: "I may not live till 2050, but this is so cool and immersive that I could vividly imagine the bright future of Guangzhou…"

Notably, there was no significant correlation between the landscape theme and the participant perception. One reason could be the uneven distributions of subgroups, which may have prevented any potential differences becoming statistically detectable (Table 4-5b). Additionally, the landscape exhibits in the Guangzhou UPEH are all well-ordered urban landscapes with water networks and high green coverage. Visitors might be drawn to and captivated by these features because they are popular elements of landscape design (Kaplan & Kaplan, 1982; Wang et al., 2016). The interaction plots represented the combined effects of scale, media and size on time spent at each visualisation. The result helps to understand the suitable size for visual media and the efficiency of tools used for each planning scale. However, given the small sample size in certain subgroups (Figure 4-8b, Figure 4-9b, Figure 4-10b), these data should be carefully interpreted to avoid potential false-positive errors (Field, 2013).

4.2.5 Conclusion

This section examines the landscape representations in the Guangzhou UPEH and the impact physical display and its content can have on visitor perception. The findings indicate that, despite their diversity in form and representation, the landscape themes in the Guangzhou UPEH tend to

emphasise landscape planning and historical conservation while ignoring the theoretical and technological dimensions. Additionally, it demonstrates that participant perceptions of these exhibits were statistically related to the planning scale, the media type, and exhibit size. In a culturally specific context, this study lays the groundwork for UPEHs to assess and adjust their curatorial practices. In the larger context, it contributes to a more effective use of visualisation media for planning communication and stakeholder engagement.

4.4 Chapter summary

This chapter reviews the phenomenon of urban planning exhibition halls in China concerning their effectiveness in stakeholder participation and planning communication through a repeated measures design approach conducted before, during and after participants' visits to the UPEH. Despite a significant increase in stakeholders' perception of participation levels in urban planning following their visits, they remain at the rung of "being informed", calling for an improvement in participatory channels by the UPEHs and increased stakeholder awareness in urban planning. It was found that UPEHs are equipped with a variety of advanced visualisation media, and participants significantly improved their knowledge of urban planning after exposure to these tools. Stakeholders' social-demographic factors played a minor role in the development of their knowledge, suggesting that the UPEH could serve as a platform for inclusive learning.

The study revealed that stakeholder perceptions of the visualisation tools in the UPEHs were statistically associated with the planning scale, exhibit media, and media size. Stakeholder characteristics did not show any significant difference in their perception of visualisation media and them learning through it. However, factors including the length of the participants visit, their

prior level of education, and the physical design of exhibitions were found to influence their preference for the displays in the UPEH. The finding lays the groundwork for planning exhibitions to assess and adjust their curatorship for better involving stakeholder participation and planning communication.

Chapter 5 - Subdistrict level - Pazhou Internet Innovation Cluster

This chapter introduces the development of the Pazhou Internet Innovation Cluster at the subdistrict level in Haizhu District, Guangzhou (Figure 5-1). The area has undergone decades of planning revolution in upper planning levels. This study primarily focuses on the detailed regulatory plan and detailed construction plan (Figure 5-2) of the area, which is now home to domestic internet giants such as Alibaba, Fosun, Vipshop, and Tencent. In Section 5.1, through document analysis and semi-structured interviews, the researcher examines stakeholder interaction between governmental authorities, developers, design practices, and chief urban designers (RQ1) and the visualisation tools used throughout the planning process (RQ2). The study reveals limited opportunities for the general public to provide feedback and a lack of effective visualisation tools for engagement. To understand the general public's perceptions of the two planning phases and the effectiveness of more advanced virtual devices (RQ3), Section 5.2 introduces a virtual reality experiment building on a pop-up university activity in the Millennium Gallery in Sheffield.

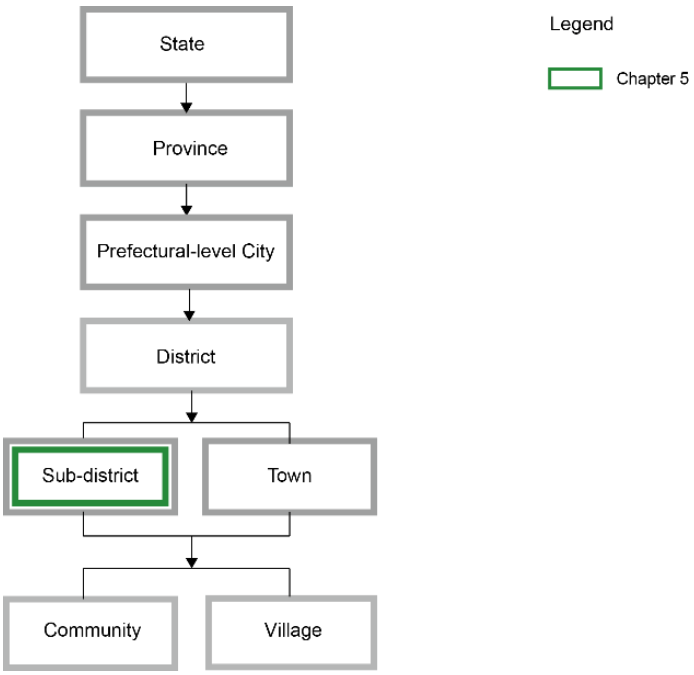


Figure 5-1 Planning scopes of the Pazhou Internet Innovation Cluster

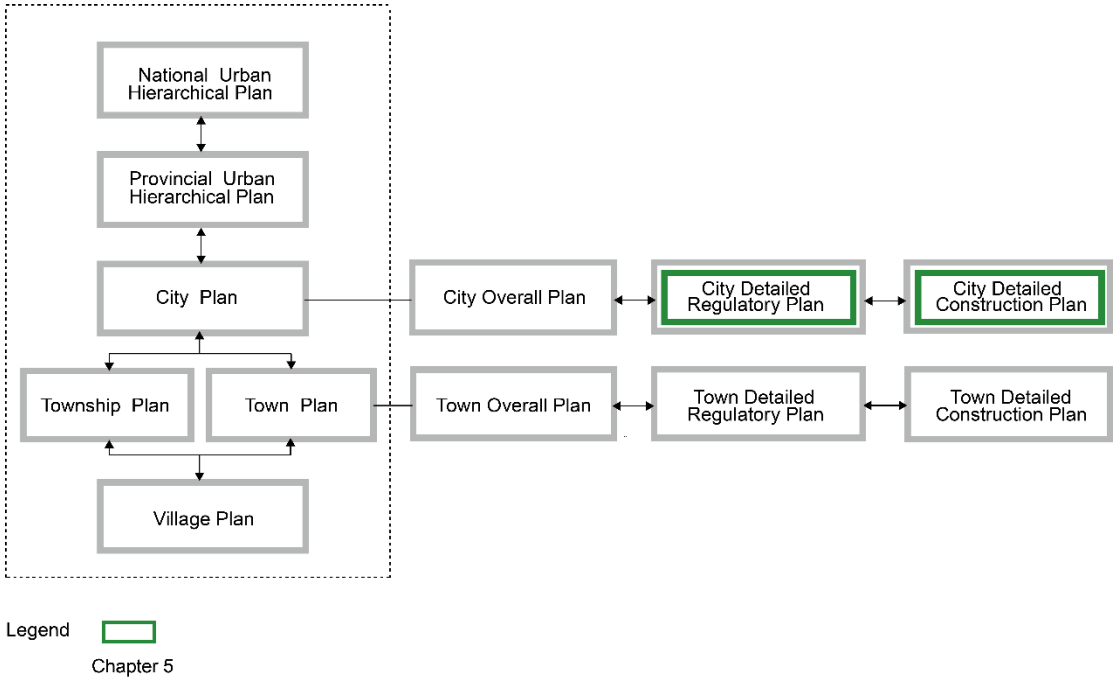


Figure 5-2 Planning information covered at the Pazhou Internet Innovation Cluster

5.1 Stakeholder analysis

5.1.1 Research context

As stated in Section 1.7, urban design for developments in city centres is not included in the statutory Chinese planning system. In practice, it is frequently enacted concurrently with detailed regulatory planning. The urban design focuses on the urban forms of the proposed development; detailed regulatory planning, based on the content of urban design, includes construction-related regulatory metrics. In most cases, commissioned planners carry out urban design, which is then incorporated into detailed regulatory planning. Following that, a land auction is held, and the right of land use is sold or allocated to landowners, who then contract varied design practices to initiate the detailed construction planning. Before implementing the proposed design, developers must

obtain “one note and two permits” for examination and approval by relevant government authorities (Chen, 2016).

Under this conventional mode, however, urban designers from architectural backgrounds tend to focus on the spatial layout of the area, with little knowledge about land development, economy, and market operations. Thus, the blueprint of an urban design may encounter difficulty when being turned into real-world practices (Sun et al., 2019). In addition, approval of detailed regulatory planning, detailed construction planning, and planning permits are regulated by certain governmental authorities, who may not fully understand the intention of urban designers. These often result in an inconsistency concerning detailed regulatory planning, detailed construction planning, and its final implementation.

Pazhou Internet Innovation Cluster is a proposed e-commerce cluster in Guangzhou, China, featuring major Chinese internet and high-tech companies. As one of the financial centres in the city’s overall planning (Figure 5-3), it is considered the key intellectual base to connect with the Guangdong-Hong Kong-Macao Greater Bay Area. The project innovatively incorporates the chief urban designer system, highly professional competencies that monitor the entire development stage from urban design and detailed regulatory planning, through detailed construction planning, until its implementation (Sun et al., 2019). The dynamic stakeholder categories and great social influence of the project provide opportunities to understand the operation and effectiveness of stakeholder participation (RQ1) and visualisation tools (RQ2), which sheds new light on the nationwide rapid urban development.

Figure 5-3 Geographic location of the Pazhou Internet Innovation Cluster
Source adapted from: Guangzhou urban and rural planning bureau

The statutory development process of the area is shown in Figure 5-4. This study looks at planning evolution from 2015 to the present implementation. Phase 2015 (P2015), or detailed regulatory planning, addresses regulatory indices of the development defined by the chief urban designers from the South China University of Technology (SCUT) (Figure 5-5a). The land was then leased to different developers through bidding and auction. Per the requirement determined in the higher-level planning, the detailed construction planning in Phase 2018 (P2018) is mainly concerned with architectural design. These are influenced by the different landowners and international design companies, including NBBJ, Jean Nouvel Ateliers, Gensler, GMP, etc. (Figure 5-5b). Regular meetings were held for monitoring the planning progress, co-hosted by chief urban designers and

relevant government authorities. At the time of writing, most projects have started construction and a few have already been put into use.

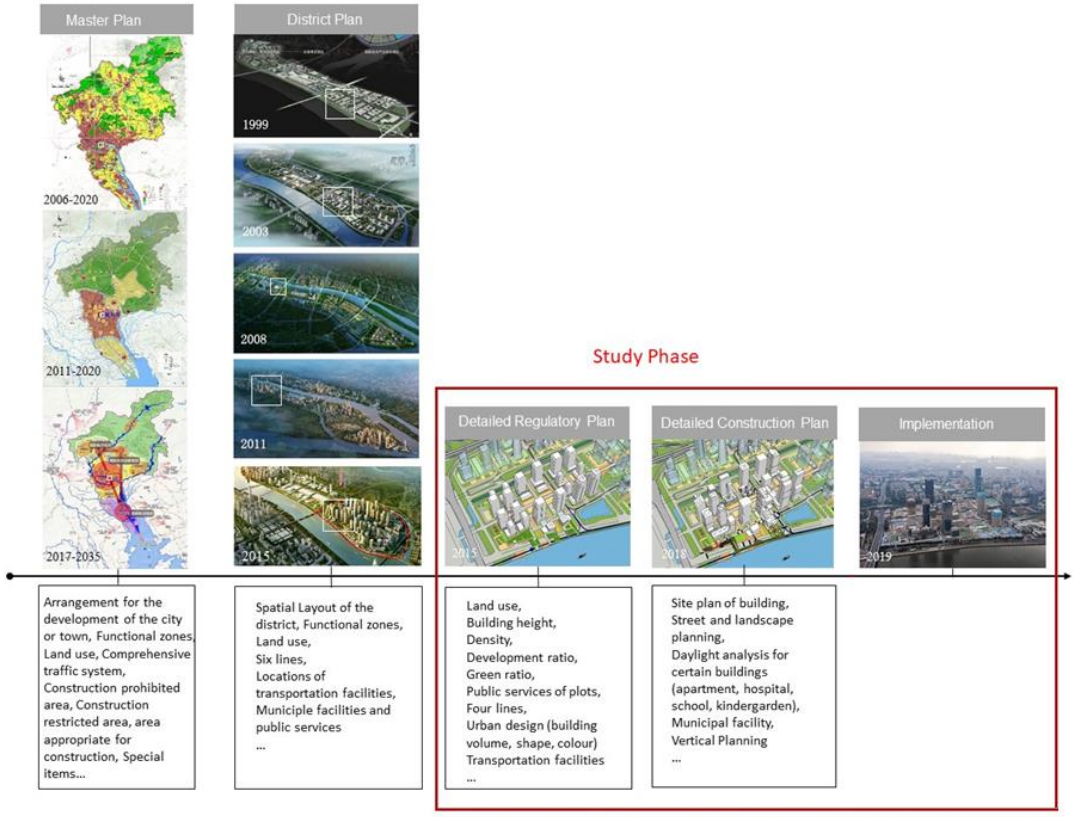
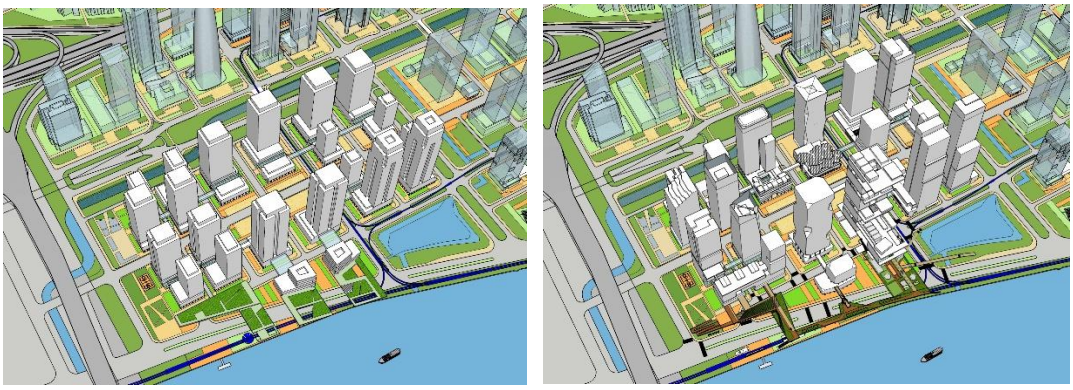


Figure 5-4: The statutory development process of PIIC, Guangzhou, China

Source: adapted from Guangzhou Natural and Urban Resources Bureau; Note: Planning moves from master plan to district and detailed plan (including detailed regulatory plan and detailed construction plan). This study focuses on the latter two phases, in 2015 and 2018, respectively.



(a) P2015 (b) P2018

Figure 5-5 Two planning phases of the Pazhou Internet Innovation Cluster

Note: left: detailed regulatory planning; right: detailed construction planning
Source: adapted from Yimin Sun Studio, South China University of Technology, Guangzhou

5.1.2 Method

After the approval of detailed regulatory planning in 2015, the study focused on stakeholder interaction and the use of visualisation media at the four stages: (1) before and during the land auction; (2) planning formulation of the detailed construction planning; (3) planning examination and approval; and (4) planning implementation. The chief urban designer team from SCUT is part of the Adaptive Urban Transformation (AUT) project, in collaboration with the University of Sheffield and TU Delft. Through this connection, a pilot interview was first conducted with two members of the chief urban designer team in October 2018. Through snowball sampling methods, the researcher connected with other four urban designers from the same team and gained more insights into the project.

Due to privacy concerns for the proposed urban development, the researcher was unable to participate in the stakeholder meetings in person; I also encountered difficulties approaching other stakeholder groups, particularly developers, commissioned design institutes and practices, and government authorities. As such, referring to the various stakeholder analysis methods in Chapter 3, a combination of semi-structured interviews, document analysis and observation was used to investigate the operation and effectiveness of stakeholder participation (RQ1) and visualisation tools (RQ2).

The semi-structured interviews with chief urban designers used the following guidelines:

1. Who are the stakeholders and what role do they play in the project?
2. How did you interact with other stakeholder groups at different planning periods?

3. Through what kind of visualisation media did you interact with other stakeholders and what role did visualisation media play in the project?

Apart from the chief urban designers' insights into the project, document analysis was conducted based on official documents, meeting notes, press releases, and journal publications. These were provided either by members of the SCUT or by online resources (see Appendix K for the list of documents). Similar to the interview guidelines, the document analysis focused on the following themes: (1) stakeholder categories; (2) means, frequencies, and content of stakeholder interaction; and (3) categories and effects of visualisation media throughout the planning process.

Fieldwork on the construction site was performed to get a deeper understanding of the ongoing planning implementation between October 2018 and January 2021. The researcher looked at the publicity information on-site as required by the local regulations (see Chapter 3) and the use of visualisation media for planning communication. Security personnel watching the entrance of the construction sites were consulted regarding the use of visualisation media and means of stakeholder participation where appropriate. Table 5-1 gives a summary of the interviewees' information. They were approached through snowball sampling methods in the chief urban designer's teams and through fieldwork to relevant construction sites.

Table 5-1 Characteristics of interviewees

Participant No.	Age	Gender	Role	Company/Institute
1	40-50	Male	Vice chief urban designer	Urban designers from SCUT
2	30-40	Male	Associate designer	Urban designers from SCUT
3	30-40	Female	Associate designer	Urban designers from SCUT
4	30-40	Female	Associate designer	Urban designers from SCUT
5	20-30	Male	Assistant designer	Urban designers from SCUT
6	30-40	Male	Assistant designer	Urban designers from SCUT
7	50-60	Male	Security personnel	Alibaba Company
8	50-60	Male	Security personnel	Huanglong Company

Interviewees' responses and document analysis were transcribed and categorised in a deductive approach in the NVivo 12 software. The themes were formulated according to different planning phases (land auction, planning formulation, examination and approval, planning implementation) and research questions (stakeholder participation, visualisation media). Relevant transcripts were coded and analysed according to the central ideas related to the research themes.

5.1.3 Results

As shown in Table 5-2, eight types of stakeholder groups were involved during different processes of the project, in which developers and design institutes, chief urban designers, and governmental authorities in charge of planning and natural resources played key roles. Appendix M lists different types of visualisation media used throughout various planning processes, which are explained in the sections below.

Table 5-2 Stakeholder groups in the project

Number	Stakeholder categories	Description	Involvement period
1	Chief urban designers	Urban designers from SCUT who coordinated with the entire planning process throughout urban design, planning formulation, approval and implementation	Before and during land auction; planning formulation; examination and approval; planning implementation
2	Developers	13 Internet companies who purchased the 17 parcels of land, including Alibaba, Tencent, Xiaomi, Huanglong, Guomei, Fosun etc.	Before and during land auction; planning formulation; examination and approval; planning implementation
3	Design practices for building design of each plot	Commissioned design practices for each developer, such as NBBJ, Jean Nouvel Ateliers, Gensler, GMP etc.	Planning formulation; examination and approval
4	Municipal government authority in charge of land resources	Governmental officials from Guangzhou Municipal Planning and Natural Resources Bureau, who were directly responsible for the project	Before and during land auction; planning formulation; examination and approval; planning implementation
5	Design institutes/practices facilitating	Design institutes facilitate aspects such as transportation, environmental evaluation, architectural design. South China University of Technology; Guangdong Provincial Architectural Design Institute; Guangzhou Transportation Planning Research Co.; Guangzhou Urban Planning and Design Institute; Beijing Jingcheng Jiayu Environmental Technology Co., Ltd.	Planning formulation; examination and approval
6	Other government authorities at the district and city level	Haizhu District government; Guangzhou Development and Reform Commission; Guangzhou Housing and Urban-rural Development Committee; Guangzhou Municipal Commission of Commerce; Other departmental authorities	Planning formulation
7	Public representatives	Those who live or work in the city, whose interests may be affected by the case study. These include public representatives, news media, experts etc.	Examination and approval
8	Construction team	Site construction	Planning implementation

Note: the sequence of stakeholders was sorted according to their involvement degree in the project.

5.1.3.1 Before and during the land auction

As mentioned in Section 5.1.1, in the conventional mode, after the detailed regulatory plan is approved, the municipal land department will remise the right to use the state-owned land through bidding and auction. In the current case, however, the ownership of individual land has already been decided between land departments and developers before the land auction. Interviewee 2, who guided the governmental land consolidation processes and banking transactions, mentioned, "Land use, building location, and specific land metrics have already been discussed with leading internet giants, to enhance the social-economic impact of the site and meet the requirement in the upper-level plan." This indicates that the land auction is a mere formality based on prior negotiation.

During this stage, publicity information is only available on government websites via text information. Figure 5-6 shows an example of the Kangmei Pharmaceutical Co. Ltd**,** which successfully remised the land use of the plot. The online publicity information illustrates the location, land use, size, usage period, plot ratio of the land, and the bidding process. In certain cases, the government website also includes the computer-aided design (CAD) details of the proposed development.

地块位置	海珠区琶洲互联网创新集聚区跨市政道路连接体⑩-2 号地块
土地用途	商务设施用地（B2）兼容商业设施用地（B1）
土地面积（平方米）	317.7
出让年限	商业、旅游、娱乐用地 40 年；综合或者其他用地 50 年
成交价（万元）	820
配建面积（平方米）	0
受让单位	康美健康产业投资有限公司

Figure 5-6 Publicity information on government website about land auction
Source from: Guangzhou Municipal Planning and Natural Resources Bureau (2017)

5.1.3.2 Planning formulation

To speed up the progress of planning formulation, more than 718 stakeholder meetings were held between 2015 and 2018 (Guangzhou Municipal Planning and Natural Resources Bureau, 2016). Meetings were organised and coordinated among three key stakeholders (see Figure 5-7): developers and design institutes, chief urban designers, and governmental authorities in charge of planning and natural resources. First, when developers and designers had obtained primary consent, chief urban designers organised consultation meetings for the initial assessment. Meetings were then proposed by the Guangzhou Municipal Planning and Natural Resources Bureau or the government authority in the Haizhou District to assess interim results (Guangzhou Municipal Planning and Natural Resources Bureau, 2016). Other design institutes or governmental authorities took fewer active roles in the negotiation process, facilitating aspects of design and planning (Figure 5-8).

According to Interviewees 1, 3, 4, and 5, chief urban designers played multiple roles in the planning formulation process, "answering directly to the Municipal Planning and Natural Resources Bureau, providing consulting services to land developers and design institutes, protecting public interests, and facilitating design assessment." Government authorities "organise expert meetings and evaluate design during the latter stage" (Interviewee 2). However, "despite the active involvement of the privileged group in the planning formulation, members of the public were rarely engaged in the stakeholder meetings" (Interviewee 6).

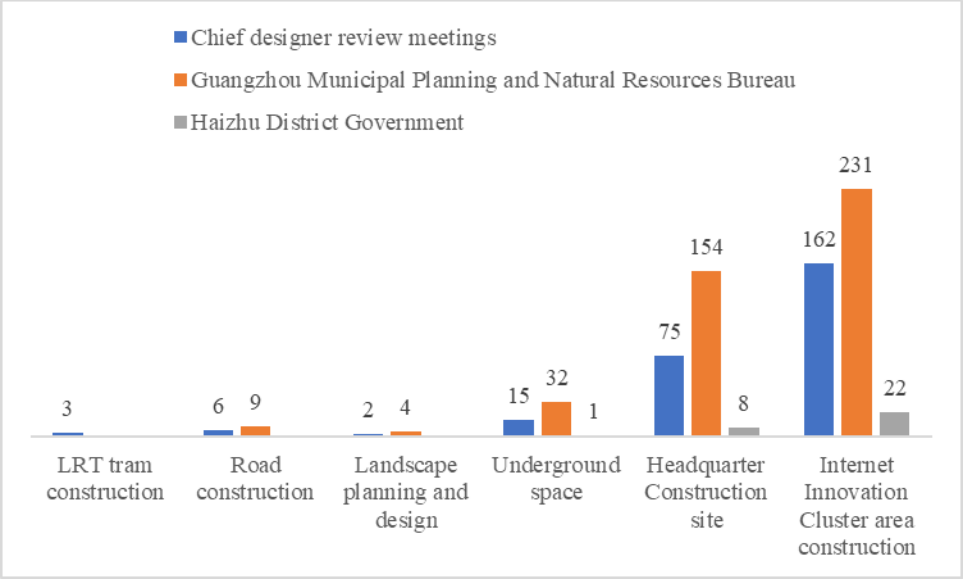


Figure 5-7 Records of stakeholder meeting from 2015 to 2018

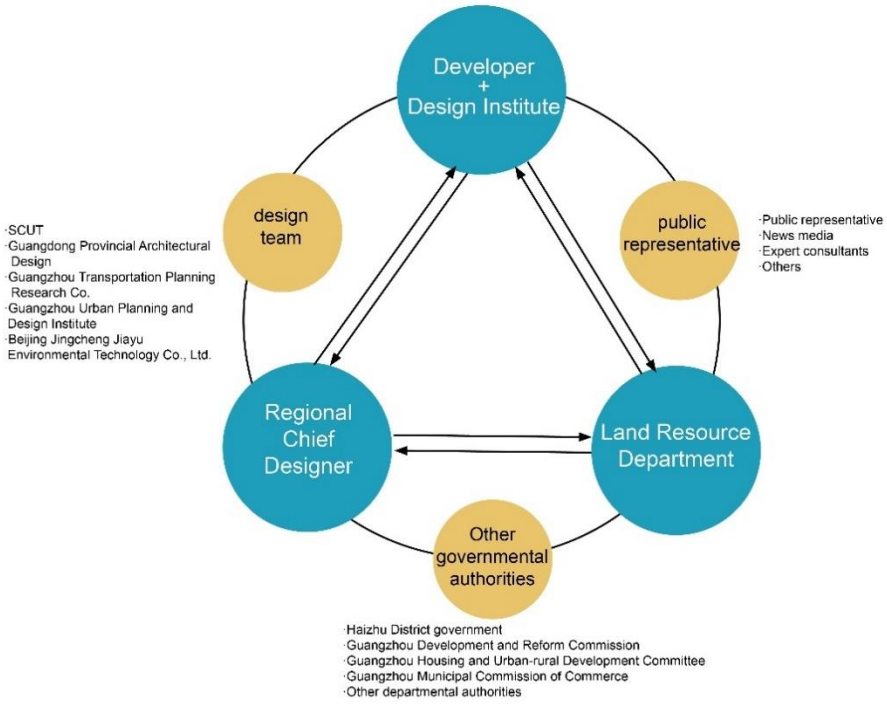


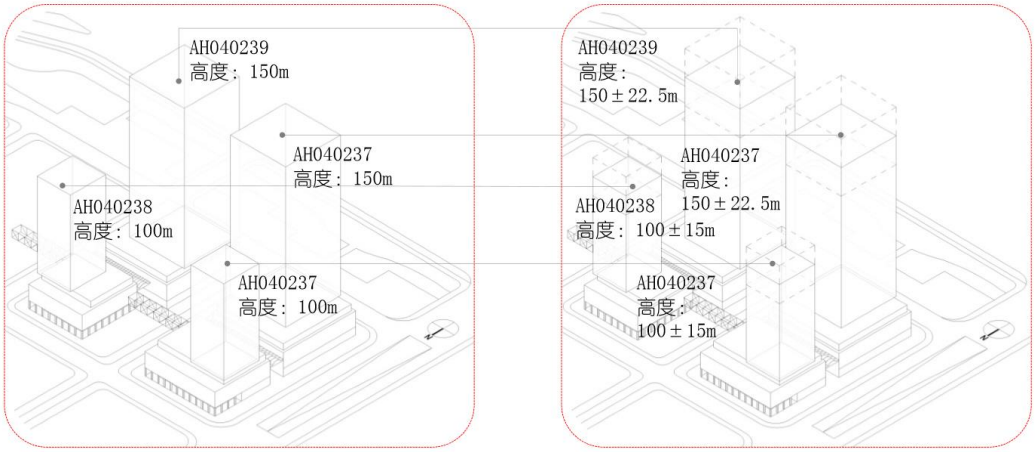
Figure 5-8 Diagram of stakeholder interaction during the planning formulation stage

At each stakeholder consultation, commissioned design institutes were asked to provide a 1:200 physical scale model of the proposed design to assess its compatibility with other buildings (Figure

5-9). In addition, “PowerPoint slides with 3D renderings, 2D maps and text information illustrating the design proposal, consultation contents and site information were used for informed understanding for stakeholder negotiation” (Interviewee 1).

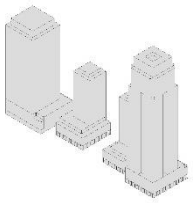
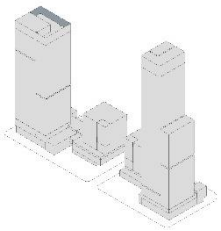
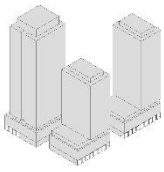
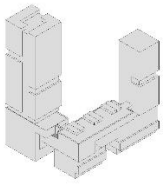
Figure 5-9 3D physical models showing the proposed site construction

These visualisations of architectural design have been known to challenge initial plans and alter decision-making processes as a result of stakeholder negotiations, including private interests from developers and chief urban designers standing for the public interests. Interviewee 2 stated, “Building height and building density were indicators pre-determined by chief urban designers in the detailed regulatory planning in 2015, allowing for no more than 15% fluctuation in the detailed construction planning (Figure 5-10). However, this rule was often broken in the stakeholder coordination process.” Examples including Vipshop, Fosun, Tencent, and Alibaba are listed in Figure 5-11.



P2015 P2018

Figure 5-10 15% allowance of fluctuation in the predefined building height

	P2015 Detailed regulatory plan	P2018 Detailed construction plan	Architectural rendering
a. Fosun			
b. Vipshop			

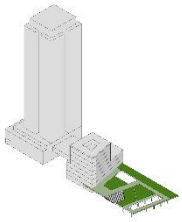
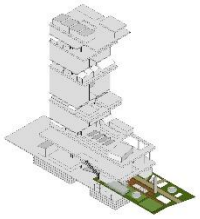
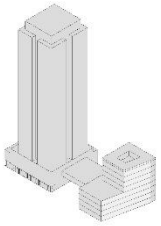
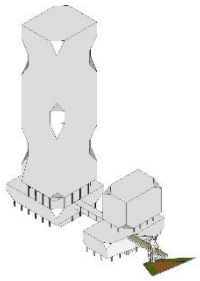
c. Tencent			
d. Alibaba			

Figure 5-11 Design evolution of Fosun, Vipshop, Tencent and Alibaba building
Source: Rendering image from relevant design institute; Sketch up models from Yimin Sun studio.

Concerning the Fosun block (Figure 5-11a), according to Interviewee 2, "The developer wished to change the height of the middle building in the plot from 100 m to 60 m. Through negotiation with chief urban planners, Fosun offered to cut a 1000 m^2 sinking square in front of their buildings for public use." This would form a multi-level green public communication platform, providing an open public space enabling various public activities.

Concerning the Vipshop building (Figure 5-11b), Interviewees 2 and 4 mentioned that "The initial detailed regulatory plan for this parcel was three high buildings forming an L-shaped layout." However, to create a unique architectural exterior and to permit connections between different building blocks, "The design team and developer sought to lower the tower in the middle of the L-shaped layout." In this case, it happened to provide "a better river view for the plots situated

relatively far away from the river" (Interviewee 3). Thus, the chief designer teams agreed with Vipshop to change the height of the tower.

Regarding the Tencent building (Figure 5-11c), according to Interviewee 6, "The architects were inspired by the architectural style of the Cantonese culture and planned to set outdoor terraces with small house blocks at different building heights for intercommunication." However, this would affect the compatibility with the surrounding buildings. "As a compensation, they offered the underground floor and first-floor platforms, which are interconnected to the waterfront elevated pedestrian promenade, for public use."

As shown in Figure 5-11d, the scale and façade of the Alibaba building were criticised over several rounds in the coordination meeting held by the chief urban designers and Municipal Planning and Natural Resources Bureau, and the suggestion was made to "diversify the building façade design, particularly for the podium." However, according to Interviewee 2, the developer was in a rush to start construction; despite design practices offering more than 20 alternatives, they were reluctant to adjust the façade design after meeting the requirement for the detailed construction plan. "Stakeholder meetings sought to find an optimised way for improving architectural design during application for building permits while maintaining implementation speed."

5.1.3.3 planning examination and approval

After consensus had been reached among different stakeholders in planning and design, developers needed to apply for the approval of detailed construction planning. Relevant information was required to "be publicised on governmental websites for a period of 30 days before approved by

relevant governmental authority" (SCPC of Guangzhou, 2015). At this stage, it was the public's opinions that were sought. However, according to the meeting records, not a single piece of public feedback was received on the proposed developments.

Approved planning information can still be found on the relevant governmental websites. Figure 5-12 shows an example of publicity after approval of the detailed construction planning of Alibaba building, which only consists of text information illustrating building details such as land use, plot ratio, floor area, greening rate, and a technical plan of its first floor (LRUPB of Guangzhou, 2016).

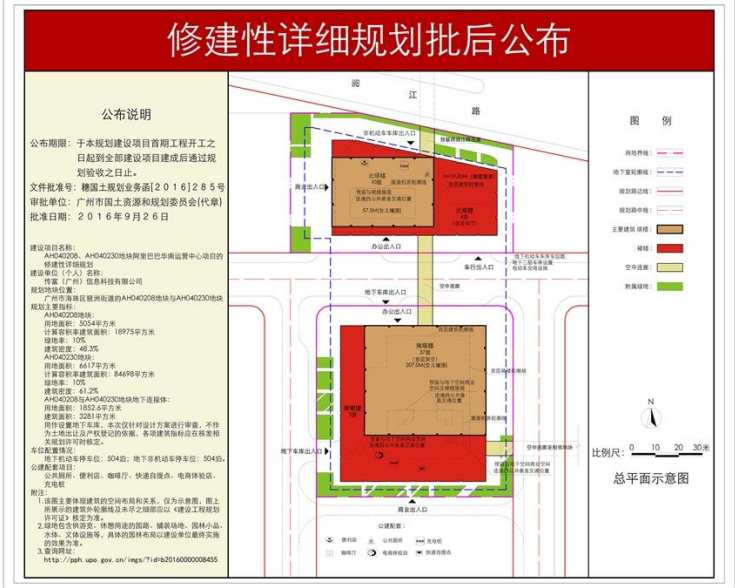


Figure 5-12 Publicity after approval of the detailed construction planning of Alibaba building in the governmental website
Source: LRUPB of Guangzhou (2016)

5.1.3.4 Planning implementation

As mentioned in Section 3.2.2, after the developers are granted necessary permits (one note and two permits) for implementation, local regulation requires an on-site publicity board to be established for public supervision until the construction is completed and the quality is examined

(LRUPB of Foshan, 2015; SCPC of Guangzhou, 2015). Normally, the "Publicity board should include planning permits, site plan, building façade images, regulatory indices, and complaints hotline" (LRUPB of Foshan, 2015).

However, during fieldwork, very limited publicity information was found on the construction sites. In front of the Vipshop building, an image showing the 3D rendering of the proposed development was displayed without any detail on the architectural design (Figure 5-13). For the rest of the buildings in construction, not a single on-site publicity notice was found. Security personnel watching the entrances of different building blocks explained this situation. Interviewee 7 responded: "There was one illustrative poster, but it got damaged in the rain and was torn off." Another security Interviewee 8 revealed that "I am not clear about the process, and nobody has sought to explain it to us or ever regulated our behaviours."

Figure 5-13 Construction site of the Vipshop company.
Note: In the entrance, there is a rendering image of the proposed site development

5.1.4 Discussion

The negotiation between local governmental authorities, chief urban designers, and developers, e.g., in the land auction and planning formulation process, highlighted a pro-growth coalition for the speedy development of the area. This is in line with Zhang (2002), who argued that during China's transition to the market economy, the public sector is gradually losing control over resource allocation; thus, they have to approach non-public sectors for secured economic development.

In contrast to the conventional mode, where inconsistency between detailed regulatory planning and detailed construction planning was common due to different responsible bodies at various planning stages (Sun et al., 2019), chief urban designers act as brokers throughout the entire planning process, coordinating the interests of land developers, relevant design institutes, and government authorities. As a result, the planning process can generally preserve the original blueprint. The chief urban designer system, as one of the first attempts in China, has implications for other planning projects by facilitating stakeholder dialogue and guiding urban development.

Differing from the professional groups' active involvement throughout the project, the public was not properly identified and was only informed during the examination and approval stage via government websites. This could be because the public was not viewed as the primary beneficiary of the site during planning formulation. This is in line with the statutory requirement about public participation (see Section 3.2.2). Additionally, no feedback was received at this stage. One reason could be that the information is only available online for a limited period, the general public may not check the government websites frequently. Furthermore, the developers' failure to conduct on-

site publicity demonstrates the importance of strengthening the supervision mechanism for stakeholder participation during the implementation stage.

While the public is somehow marginalised in the planning process, chief urban designers tend to advocate that they take the normative position as public interests (Alexander, 2002). The question that arises is how they understand and represent the public interest. Planning is a political process that involves the allocation of land, resources, and facilities. It is not a win-win situation, which necessitates the professional credibility of chief urban designers to provide options to those who make decisions and those who are impacted (Grant, 2005; Howe, 1992). If chief urban designers fail to act in the best interest of the public, then the public is impacted, and their rights are violated. This suggests that the general public should continue to strive for personal integrity, remain informed of differing viewpoints, and work to advance social equality.

The use of visualisation media, including 3D physical models, 2D maps and renderings of digital models during the planning formulation process, was found to facilitate the stakeholder dialogues, planning, and design directly. This aligns with the visualisation studies in earlier participatory planning settings (Lewis Gill et al., 2013; Schroth et al., 2015; Wissen Hayek, 2011). It may facilitate altering the decision-making process, as evidenced by the negotiation process between different actors about established regulatory indices in detailed regulatory planning.

In contrast to the dynamic visualisation tools used during the planning formulation, the publicity data on the government website consists solely of a two-dimensional floor plan of the proposed building. Generally, the public is more likely to be concerned with the outside of the building and

how it fits into its context. A floor map with regulatory indices is too technical for them to derive meaningful ideas about the proposed building appearance. This necessitates the use of more intuitive and immersive methods to aid public comprehension, as well as the provision of additional visual information about the outside of the building and its compatibility with its surroundings.

5.1.5 Conclusion

This section introduced stakeholder participation in an urban development project in Pazhou, Guangzhou. Through semi-structured interviews, document analysis and on-site observation, it investigated stakeholder interaction at varied planning phases with the use of visualisation media. The role of chief urban designers in bridging dialogues between local government authorities and developers was highlighted. While the planning formulation stage used a variety of media which effectively contributed to planning communication and changes in stakeholders' attitudes, the public was only later informed about the project via a 2D technical plan. This necessitates broader engagement utilising intuitive visualisation media.

5.2 Public perception of planning phases of the Pazhou Internet Innovation Cluster

5.2.1 Research context

The urban planning process usually develops gradually over time; however, it can sometimes be interrupted by internal and external environmental factors, resulting in a directional shift (Hersperger et al., 2018; Masser, 1983). Therefore, more emphasis has been placed on scenario planning as a strategy for responding to stakeholders' needs and expectations (Amer et al., 2013;

Xiang & Clarke, 2003). Studies examining the relationship between visualisation media with planning alternatives frequently focus on contrasting scenarios at a time rather than on scenarios that develop over time. Gradual and sequential changes in planning, and how individuals perceive or react to them, have not been examined thoroughly.

With stakeholder inputs, the detailed regulatory planning (P2015) of Pazhou Internet Innovation Cluster gradually developed into detailed construction planning (P2018). In Section 5.1, I argue that, despite the active participation of the professionals, government authorities and developers, the general public didn't play any substantial role in the project; Visualisation tools used for communication with the public only supports passive communication. Therefore, the second experiment aims to examine whether there are significant differences between the various stakeholders in perceiving the two sequential planning phases of urban development through immersive VR devices (RQ3).

5.2.2 Method

Concerning the difficulty in preparing the space and suitable equipment to conduct a VR experiment in Guangzhou, as well as to mitigate volunteer bias that may occur during self-selection recruitment in a laboratory setting, the experiment took advantage of the Pop-up University activity, a three-day public event, held from September 20th-22nd 2019 at Millennium Gallery in Sheffield, UK (see Figure 5-14). The Millennium Gallery is a well-known landmark in the city, attracting various visitors. Apart from the researcher, team members included Prof. Eckart Lange, Dr. Sigrid Hehl-Lange, Dr. Adam Tomkins and Ms Ziyi Liu (Figure 5-15). I mainly led on the negotiation with the exhibition organizing committee, questionnaire design, formal analysis, writing up the experiment and publications.

Figure 5-14 Pop-up university activity at Millennium Gallery, Sheffield

Figure 5-15 Members of the exhibition team

Note: From left to right: Sigrid Hehl-Lange, Ziyi Liu, Xi Lu (me), Adam Tomkins, Eckart Lange

The experiment followed five steps as shown in Figure 5-16. First, visitors who showed an interest in engaging with the VR exhibition were recruited. They were then informed, both verbally and in writing, about the context of the project and asked to sign the consent form (See Appendix G). They were in turns allocated to one of the two planning phases, ensuring each phase had an adequate number of participants. They were then introduced to a VR head-mounted device and its operation through which they could navigate following a pre-defined route in the virtual environment (VE). Viewing patterns of participants were monitored through automated 3D gaze tracking. Finally, follow-up questionnaires were given to examine their spatial perception of the virtual environment. These included examining their attitudes towards the VR device and urban design using a semantic differential scale (SDS), verifying factual variables, and testing recall of landmarks in the test.

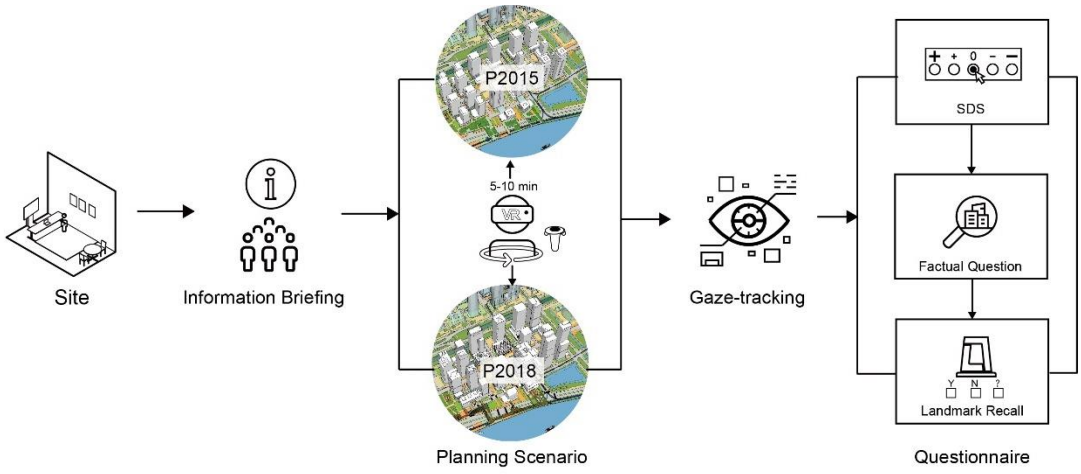
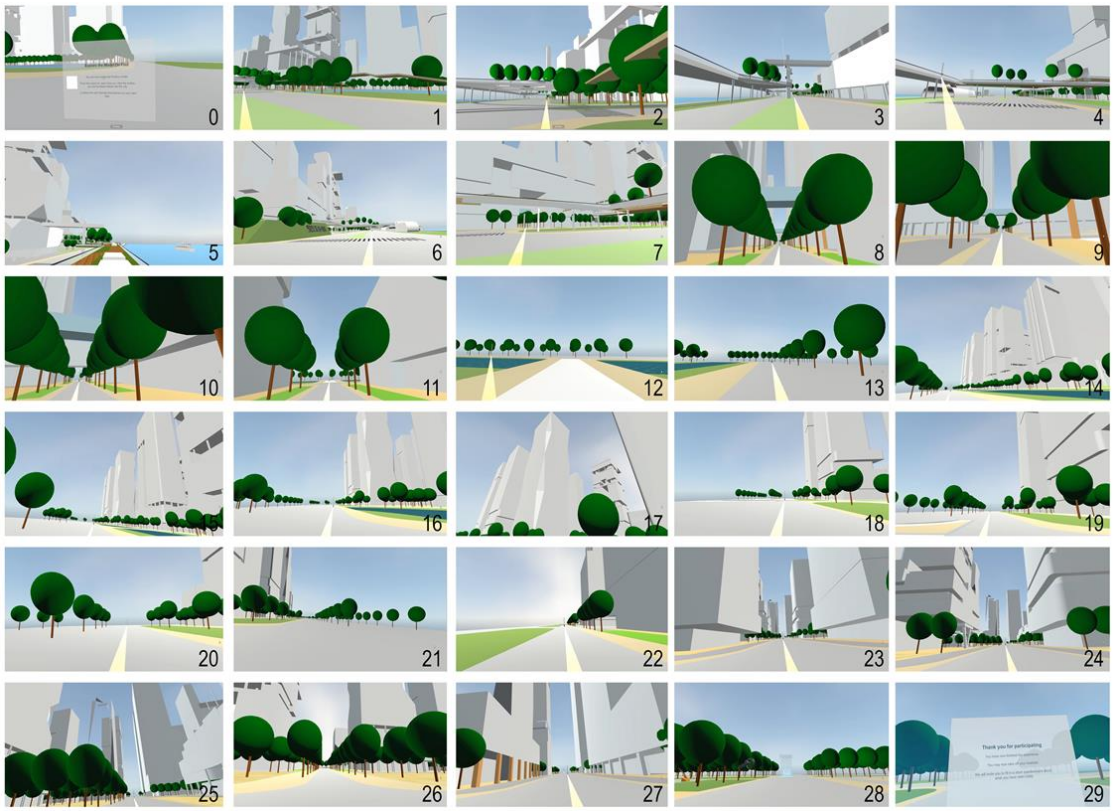


Figure 5-16 Overview of the experimental process

A predetermined route with a length of 2671 m (see Figure 5-17a) ensures that the participants were exposed to the proposed development fairly and had sufficient time to explore the design. A leap function with 30 stops across the route in the VEs was introduced, resembling the experience of a 3D walkthrough in Google Earth, based on the "serial vision" concept for illustrating human-

environment interaction (Cullen, 1995). Figure 5-17b depicts selective scenes from the participant's trip via P2018 at various waypoints. After an information briefing at Waypoint 0, it begins with a sequence of waterfront views (Waypoints 1–7) and progresses to a boulevard walkway between buildings (Waypoints 8–12). Waypoints 13–28 depicts scenes next to or between buildings. The exploration concludes with a pop-up notice at the last waypoint.

(a)



(b)

Figure 5-17 Selective waypoints and scenes on a participant's journey in P2018

(a) A pre-determined route with 30 stops in the 3D VE (b) Selective scenes at different waypoints on a participant's journey in P2018

5.2.2.1 Gaze-tracking

The terms *eye tracking*, *gaze tracking*, or *eye-gaze tracking* are frequently used interchangeably in studies involving tracking. Eye tracking detects and records the gaze points in conjunction with eye movements, which can be aggregated later to form fixations (the gaze position held for an extended period) and saccades (the movement of the gaze from one location to another) (Blascheck et al., 2014). Rather than tracking individual eye movements, gaze tracking (point of regard) analyses eye tracking data with regard to visual scene in the image or video (Chennamma & Yuan, 2013). The term *eye-gaze tracking* is used in this research to refer to the synthesis of both studies.

In planning, eye-gaze tracking studies have been undertaken in both virtual and physical contexts, employing either immersive headsets or relatively remote devices such as desktop computers and 3D CAVE systems (Boonen et al., 2019; Emo, 2012; B. Piga et al., 2011; Simpson et al., 2019). Studies employing head-mounted devices in VEs have elucidated how the public perceive two-dimensional (2D) images. For example, Dupont et al. (2014) used eye-tracking to study how individuals perceive photos of real-world landscapes. Pihel et al. (2015) evaluated the impact of planning expertise on eye movements when assessing forest biodiversity. Noland et al. (2017) studied how people react to photographs in public spaces through eye-tracking.

One limitation of these studies is that the visual patterns in the 2D VEs only show the relative positions of the user's eyes in relation to his/her head, whereas the 3D positions of the user's eyes in the real scene remain undetected (Shih & Liu, 2004). Dorr et al. (2010) and Danahy (2001) have also proposed that framing static stimuli may reduce the range of view, resulting in less natural viewing patterns. To provide a more dynamic experience for participants, recent initiatives have applied 3D virtual environments (VEs). Amati et al. (2018) tracked participants as they saw footage of walks in urban parklands in Melbourne. Zhang et al. (2019) used a virtual walkthrough on a historical street to collect participants' 3D point cloud eye-tracking data. Nonetheless, due to technical difficulties and extensive data interpretation, the visual stimulation in these studies is restricted to small-scale low-rise urban environments.

Building on Tomkins et al. (2019), a 3D gaze-tracking approach was used to investigate the fixed perspectives revealed during the navigation of the high-rise VEs. The virtual model of the study area was imported into the Unity Games Package using the FBX format for sketch-up models. To

create an immersive travelling experience, a Lenovo Explorer Windows Mixed Reality Headset was used. Through regular recordings of the position and progress of the viewports and focal points in a 3D virtual space, participants' perspectives during their virtual exploration can be reconstructed and depicted (Lu et al., 2021). Each participant was assigned a unique number that is aligned with their follow-up questionnaire. The following measurements were recorded during their virtual exploration:

1) the total amount of time spent exploring the 3D model from each vantage point;
2) the overall time spent focusing on each point in the 3D model;
3) the unique frequency of view upon each vantage point and focal point.

Data visualisation was aggregated and processed by compressing continuous participant trajectories into a discrete "voxel" 3D grid system (see Figure 5-18). In this case, the participants' spatial experience can be reconstructed and organized into a variety of visual patterns to extract maps, including the unique number of view per waypoint, voxel positions per waypoint, time of stay per waypoint. This data could be further broken down to evaluate the differences in attitudes between different subgroups concerning the two planning phases (Lu et al., 2021).

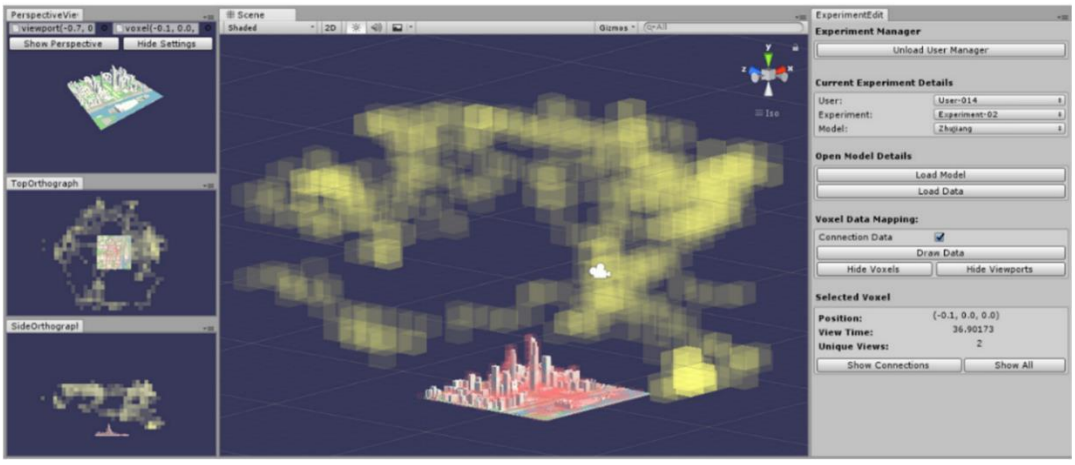


Figure 5-18 Data interpreting process of gaze tracking data.
Source: Adam Tomkins

5.2.2.2 Survey and data analysis

The combination of subjective perception and objective analysis facilitates the understanding of the spatial experience (Makransky et al., 2019). A popular self-assessment tool for soliciting opinions is the semantic differential scale (SDS), which asks users to rate the proposed surroundings using bipolar adjectives on a given scale (Osgood, 1964). Landmark, route, and survey knowledge are frequently used indices for objective measurement of spatial knowledge. Landmark knowledge assesses a participant's ability to determine whether a specific object exists in the presented environment. Route knowledge is associated with sequential learning and actions performed along the route. Survey knowledge covers the spatial layout, places, landmarks, and their interrelationship (Cubukcu & Nasar, 2005).

Participants' attitudes to the two planning phases, their knowledge of factual questions and landmark recall about the presented virtual environment were focused, building on experiments that explored human-environment interaction (Kuliga et al., 2015; Omer & Goldblatt, 2007; Willis et al., 2009), and urban design principles (Banerjee & Loukaitou-Sideris, 2011; Watson, 2003),. The questionnaire includes four parts (see Appendix I):

- Participants' socio-demographic information, including age, gender, nationality, level of education, planning expertise and prior VR experience.
- A five-point semantic differential scale (SDS) with seven pairs of adjectives was used to assess participants' attitudes towards the VR device and urban design:

  VR device; "helpful for understanding - not helpful for understanding," "easy to use - hard to use," and "realistic - abstract".

Urban design; “detailed - simple”, “interesting - boring”, “beautiful - ugly”, and “unique - repetitive”.

- Three factual tests, including estimation of the height of the tallest building (200 m) in the VE, the number of buildings (For P2015, N=19; P2018, N=14), and the distance travelled along the predefined route (2671 m).
- One landmark recall test. Participants were presented with a scorecard which contains the actual building blocks and other surrounding buildings that don’t exist in the VE (for P2015, 19 existing +11 non-existing; for P2018, 14 existing +11 non-existing). Participants were asked to tick the images of building blocks that they thought existed/did not exist in the VE or were uncertain about.

The distance/height estimates were determined based on the differences between the answers of participants and the actual data (Difference = Estimation – Reality) (Paes et al., 2017). The Difference of “Estimation – Reality” for height is ‘Estimation – 200’, and for distance ‘Estimation – 2671’. Due to the disparity between the building blocks in each planning phase (P2015 = 19, P2018 = 14), the sampling size bias for estimating the number of buildings was balanced using the disparity rate [D = (Estimation − Reality) / Reality * 100%]. In theory, the smaller the absolute results of the “Estimation − Reality” discrepancy and the disparity rate, the more accurate the results. Landmark recall tests were measured using the sum of the scores on the participants’ answer sheets, with corresponding scores balancing the accuracy rate assigned to one of the three categories: correct (P2015 = 1, P2018 = 1.13), unsure (P2015 = 0, P2018 = 0) and wrong answers (P2015 = -1, P2018 = -0.83). In response to the differences in full marks for each phase (30 for

P2015 vs28.25 for P2018), participants' test results in P2018 were scaled to a total value of 30 to compare with P2015 (Lu et al., 2021).

Data analysis was conducted through IBM SPSS version 25.0. The demographic data was examined through descriptive statistics. The internal reliability of the SDS result was examined by Cronbach's α coefficient, see, e.g. Kang & Zhang (2010) and Field (2013). The mean values of the SDS were compared using scatter plots with scores ranging from 1 to 5. The normality distribution of the SDS and spatial knowledge test results were then examined through the Kolmogorov-Smirnov test (Ghasemi & Zahediasl, 2012). Except for the landmark recall results, data from the tests were not normally distributed. The participants' overall perceptions of the two planning phases were first analysed using the Mann-Whitney test for the SDS and three factual tests, and an independent-sample t-test was conducted to assess the landmark recall results.

To understand the variation in perceptions per personal demographic component, within-phase and between-phase comparisons were conducted using suitable nonparametric (Mann-Whitney U tests and Kruskal-Wallis tests); and parametric tests (one-way ANOVA) in relation to different demographic subgroups (Field, 2013). Pairwise comparisons were carried out to confirm where significant differences occurred.

5.2.3 Results

A total of 87 participants were successfully recruited. Although there were more participants overall, because of research ethics requirements, children had to be excluded, as well as participants with abnormal vision or participants who did not complete the experiment. The demographic characteristics of participants are listed in

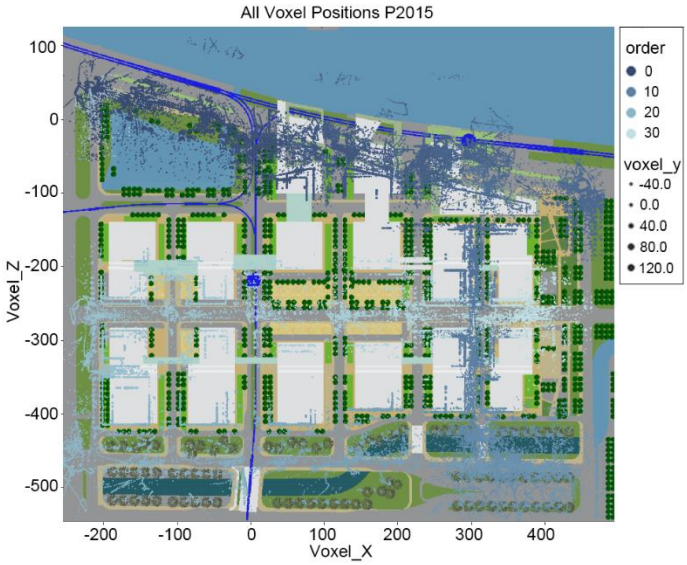
Table 5-3. As different age groups are unevenly distributed (which decreases statistical power), I primarily focus on the perceived differences between gender, ethnicity, educational level, planning expertise and prior VR experience in the two planning phases.

Table 5-3 Demographic components of effective participants

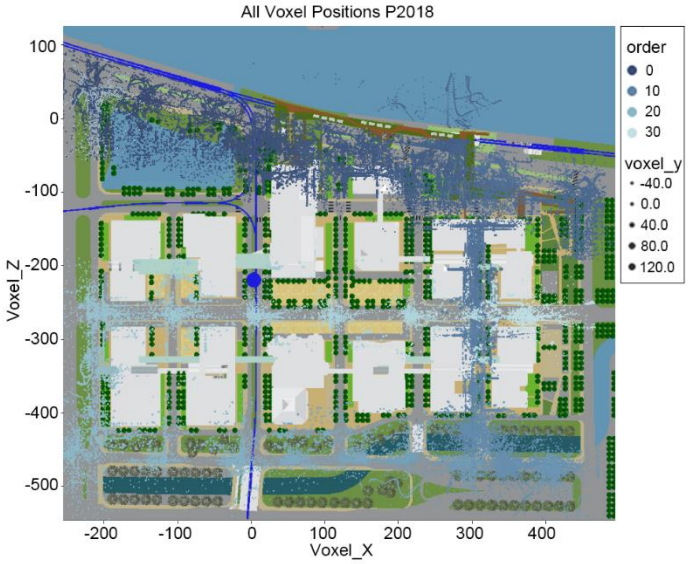
Demographic factors		P2015 N (Percentage)	P2018 N (Percentage)	Total N (Percentage)
Total		42 (100%)	45 (100%)	87 (100%)
Age	18-44	35 (83%)	39 (87%)	74 (85%)
	45+	7 (17%)	6 (13%)	13 (15%)
Gender	Female	23 (55%)	25 (56%)	48 (55%)
	Male	19 (45%)	20 (44%)	39 (45%)
Education level	No university degree	6 (14%)	6 (13%)	12 (14%)
	University degree (BA, BSc)	13 (31%)	14 (31%)	27 (31%)
	Higher degree (MA, PhD, PGCE)	23 (55%)	25 (56%)	48 (55%)
Ethnicity	Chinese	8 (19%)	13 (29%)	21 (24%)
	Non-Chinese	34 (81%)	32 (71%)	66 (76%)
Lay or professional	Professional	12 (29%)	13 (29%)	25 (29%)
	Laypeople	30 (71%)	32 (71%)	62 (71%)
VR experience	Yes	19 (45%)	21 (47%)	40 (46%)
	No	23 (55%)	24 (53%)	47(54%)

5.2.3.1 Gaze-tracking detailing when, where and for how long people navigate through the 3D virtual environment

The voxel positions, voxel numbers and viewing time at each waypoint were plotted to illustrate participants' gaze behaviours across the different phases. Figure 5-19a and b show the overall exploration patterns of the models in the 3D coordination system. The plan view of P2018 represents more divergent and intensified accumulation in the field, while P 2015 has formed a relatively closed pattern near the outline of the architecture and environment. Figure 5-20 shows that the height distributions of voxel positions in both phases range from 0 – 80m in the VEs. In both phases, there were no significant differences in terms of looking into heights. Height at 5m is most frequently looked at, over which visual attention decreases as the height grows.



(a)



(b)

Figure 5-19 Plan view of voxel positions in the two planning phases
(a) P 2015, and (b) P 2018; Source: Adam Tomkins

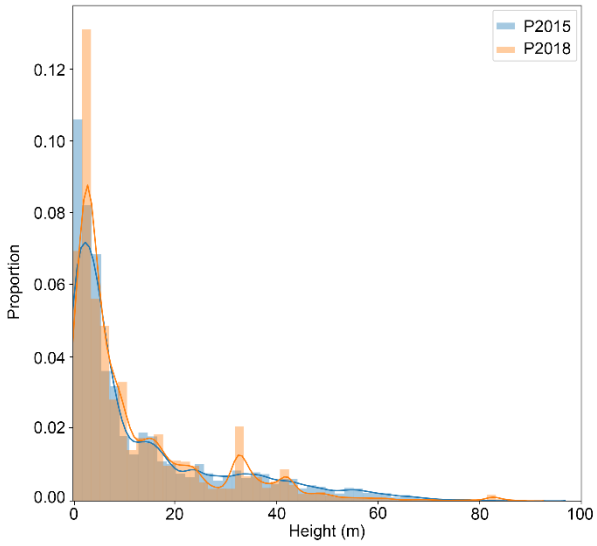
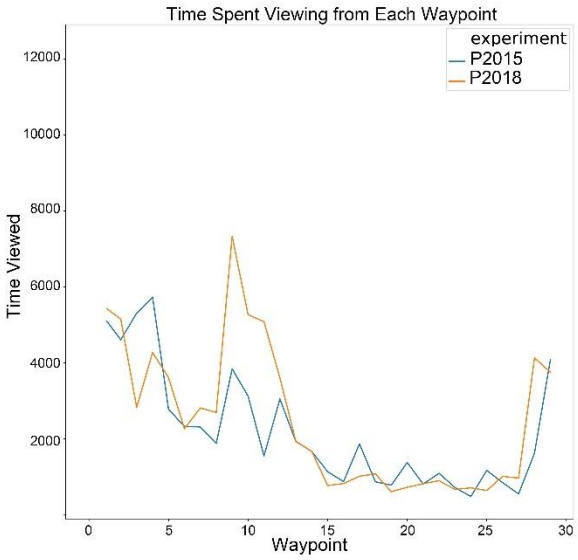
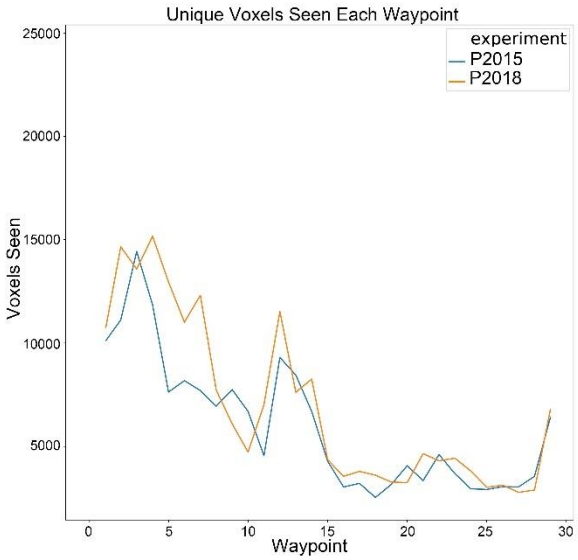


Figure 5-20 Height viewing distributions in P2015 and P2018
Source: Adam Tomkins

Figure 5-21a and b show the viewing time and voxel numbers of participants at each waypoint in P2015 and P2018. Both metrics changed early in the trip, at Waypoints 3, 5, 8, 9, and 12. They stayed low and constant until the end, when they started rising. Overall, P2018 had more voxel counts and lasted longer than P2015. Early in the journey, substantial distinctions between the two phases emerged. At Waypoints 3 and 4, P2015 attracted a longer exploration time while the voxel counts were comparable between the two phases. Despite viewing Waypoints 4–7 for almost the same amount of time in both phases, P2018 drew more voxel numbers than P2015. The extent of exploration at waypoints 9, 10 and 11 did not change significantly over time; in fact, it decreased slightly. Nonetheless, at these points, the P2018 model received more viewing time than P2015.



(a)



(b)

Figure 5-21 Visual exploration from each waypoint

(a) time spent viewing, (b) unique voxels; Note: data in Waypoint 0 is removed due to the time spent adjusting to the VEs and reading the information briefing. Source: Adam Tomkins

5.2.3.2 Spatial perception unveiled through semantic differential scale and knowledge tests

The internal consistency of participants' SDS evaluation was good ($\alpha = 0.822$). Overall, no substantial variations in SDS results were found between the two phases. Participants were optimistic towards the VR device and urban design (Figure 5-22). The VR device was considered as generally helpful for understanding, easy to use and realistic in both phases. However, P2018 was slightly preferred over P2015 in terms of urban design, such as detail, beauty, and uniqueness.

Gender, planning expertise, and education level had no significant effect on participant's perception within and between different phases. Prior VR experience did however play a role. Within P2015, participants without VR experience ($M = 4.83$, $SD = 0.39$) considered the device

more helpful for understanding than experienced users (M = 4.47, SD = 0.51) (U = 141.5, p = 0.017). Within P2018, the experienced group perceived the environment to be less realistic (M = 3.48, SD = 1.08) than the first-time VR users (M = 4.13, SD = 0.85) (U = 235.5, p = 0.037).

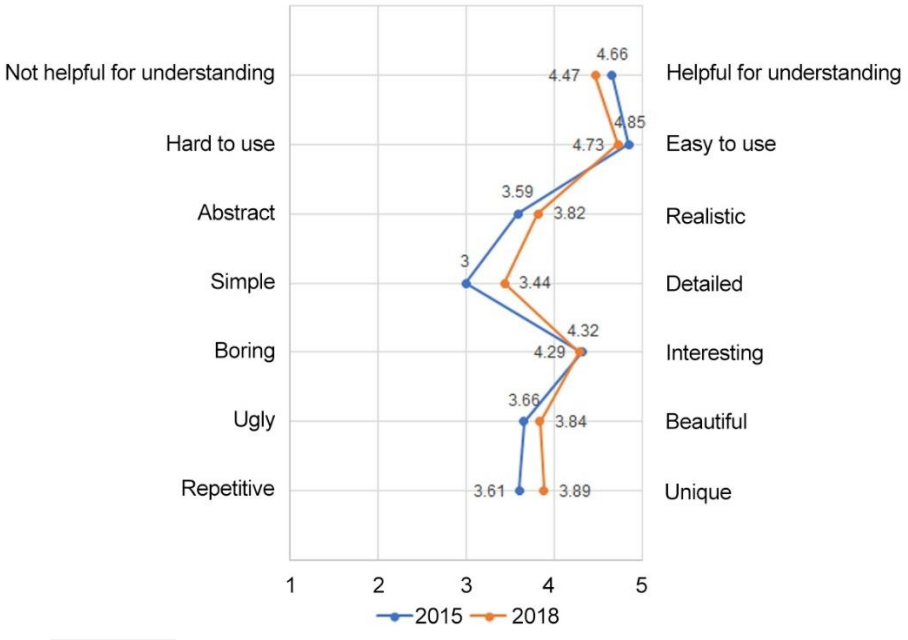


Figure 5-22 Participants' semantic differential scales of P2015 and P2018

Table 5-4 shows that there are no significant differences between participants in estimating regulatory parameters for both phases, such as height, number, and distance. Estimates for P2018 were slightly higher than those for P2015. Overall, the height of the tallest buildings in the VE was judged to be significantly lower than their actual height. Similarly, the estimated number of buildings were slightly lower than the actual number of buildings. The median of participants' estimations of the distance travelled in the VEs was significantly shorter than the actual routes. In terms of landmark recall tests, there were significant differences between the two phases: t (84) = −2.156, p = 0.034. Participants showed a substantial better result at P2018 (M = 4.82, SD = 4.26) than at P2015 (M = 2.12, SD = 7.09).

Table 5-4 Difference of estimation and reality by phase

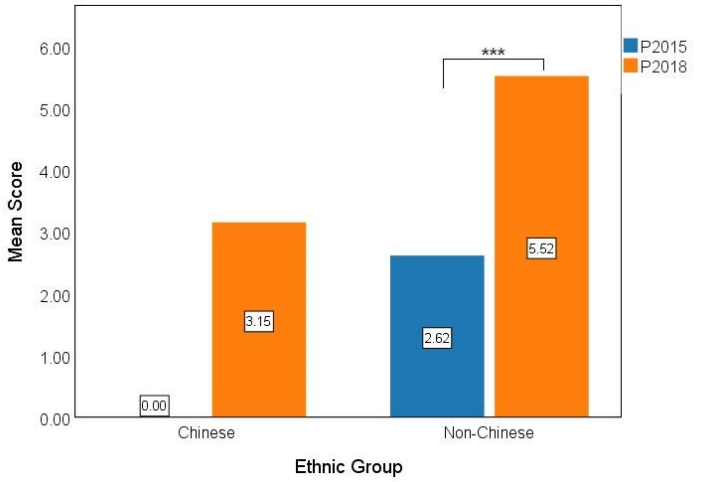
	Estimation - Reality Difference			
	Height (Height -200) m	Number (Disparity Rate)	Distance (Distance-2671) m	Landmark Recall Balanced Score
	Median (95.0% CI)	Median (95.0% CI)	Median (95.0% CI)	Mean (SD)
Phase 2015	–95 (–120, 0)	–0.08 (–0.37, 0.26)	–2566 (–2591, –2471)	2.12*** (7.09)
Phase 2018	–90 (–100, 0)	–0.07 (–0.29, 0.43)	–2561 (–2571, –2471)	4.82*** (4.27)

Note: "***" indicates significant difference, $p < 0.05$.

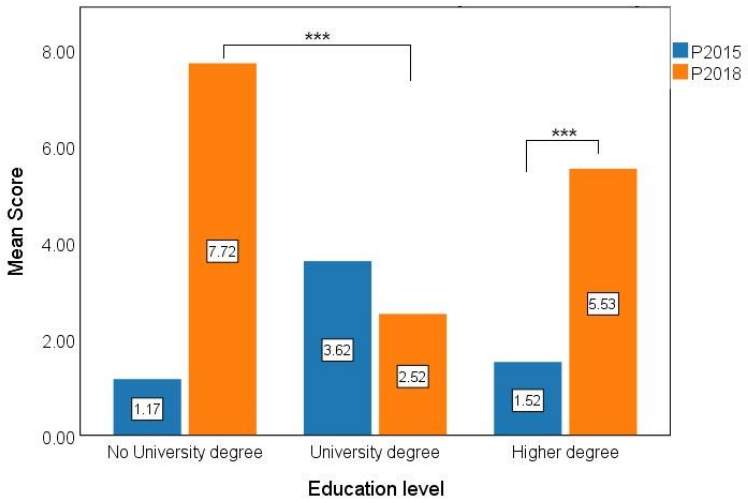
When comparing between- and within-phase variances of the two phases, all demographic subgroups (gender, education level, ethnic group, planning expertise, VR experience) did not achieve statistically significant differences concerning regulatory indices (height, number and distance). Regarding landmark recall tests, no significant differences were found in factors such as gender, planning expertise, and prior VR experience; However, there were significant differences in subgroups concerning ethnicity between the two phases. As shown in Figure 5-23a, non-Chinese groups had significantly lower scores in Phase 2015 ($M = 2.62$, $SD = 6.88$) compared to Phase 2018 ($M = 5.52$, $SD = 4.04$) for landmark recall tests ($p = 0.044$).

Education level is a significant factor in landmark recall tests between/within the phases. Figure 5-23b shows that participants with higher education degrees performed significantly better in P2018 ($M = 5.53$, $SD = 3.6$) than those engaged in P2015 ($M = 1.52$, $SD = 6.44$), t (34.193) = −2.626, $p = 0.013$. One-way ANOVA revealed a statistically significant difference between groups with various education levels within P2018 (F (2, 41) = 4.043, $p = 0.025$). Post hoc comparisons

using the Tukey's test show that in P2018, participants without a university degree (M = 7.72, SD = 4.53) outperformed those with a university degree (M = 2.52, SD = 4.40) (p = 0.043).



(a)



(b)

Figure 5-23 Clustered bar mean of landmark recall score in the two phases

(a) ethnic group, (b) education level

"***" highlights a statistically significant difference between the different subgroups.

A cross-tabulation was further conducted to evaluate the joint impact of ethnic group and education level on the landmark recall test (see Table 5-5). Given sample numbers, the statistical significance was not significant (p=0.079). However, it should be noted that all Chinese participants had a university degree or above, and Figure 5-23b shows that they had a lower recall result compared to the non-Chinese participants. This suggests a potential bias on participants' test results divided by education level (Figure 5-23a).

Table 5-5 Crosstabulation of education level and ethnic groups in landmark recall tests

Count		Ethic groups		
		Chinese	Non-Chinese	Total
Education level	Without university	0	12	12
	University degree	9	18	27
	Above university degree	12	36	48
Total		21	66	87

5.2.4 Discussion

5.2.4.1 Interpreting visual engagement in the 3D high-rise environment

In comparison to traditional studies that rely on observation and mapping techniques, such as those in Cullen (1995), Appleyard et al. (1964), and Bacon (1974), 3D gaze-tracking provides an objective and automated approach to understanding human visual dynamics during movement in the urban environment. High fixation counts are frequently associated with increased attention (Glaholt et al., 2009; Viaene et al., 2016). Increased viewing duration implies interest or engagement, which is often linked to complexity (Duchowski, 2007; Holmqvist et al., 2011). Failing to achieve both may indicate oppression and boredom.

The gaze-tracking in P2018 reveals a more dynamic and engaging visual investigation than in P2015, especially at the beginning of the VR journey. This shows that, at the more developed later phase, people are likely to gain a more holistic understanding of the proposed development. The overall higher voxel numbers and viewing time in the P2018 phase demonstrate participants' interest in the more complicated virtual model. This is consistent with Kaplan and Kaplan (1982), who highlight the significance of complexity.

Comparing viewing patterns at each waypoint of the two phases exposes perceptual differences regarding various spatial features. For instance, waterfront areas at the earlier stage of the journey received higher exploration counts in P2018 than in P2015, indicating participants' increased willingness to explore the area (Waypoints 2–7). Participants spent longer time at the urban canyon (Waypoints 9–12) in P2018 and waterfront buildings (Waypoints 3–4) in P2015, which suggests a higher level of complexity of the relevant area. Notably, participants' visual engagement with the VEs had some significant turning points (i.e., Waypoints 3, 5, 8, and 12) echoing with areas where the degree of spatial enclosure (defined by the ratio of the height of buildings to the width of the street) changed. This supports previous research on the degree of enclosure and perceptual responses (e.g. Fisher-Gewirtzman, 2018; Stamps & Smith, 2002).

The 3D exploratory patterns have revealed some common features between the two planning phases, which are of assistance in generalising the public's navigation behaviours. During the later stages of the virtual journey, there is a decline in engagement time and voxel numbers at different waypoints. One reason for this could be explained by the lack of complexity and attractiveness, implying that participants interpreted them more easily and quickly. It could also suggest visual

fatigue" during the VR experience (Wang et al., 2019). As a result, there may be order bias during the pre-designed journey. Future research could address this issue by introducing a reverse journey or randomly assigning participants to different travel routes.

Despite being in a high-rise context, the main focuses of the participants' gaze pattern were on the lower-storey environment in both planning phases. This correlates with previous eye-gaze tracking findings carried out in a low-rise real environment. E.g. Simpson et al. (2018), has addressed the impact of ground floor design of buildings along the street as pedestrians are mostly perceiving the city at eye level. This provides empirical backing for Gehl (2013) and Glaser et al. (2012) who emphasize the importance of ground floor qualities in urban design practices.

5.2.4.2 Participants perceptions of the two planning phases

In the SDS evaluation, P2018 was slightly favoured over P2015 concerning level of detail, beauty and uniqueness; In addition, participants showed a superior landmark recall of the P2018 phase compared to that of the P2015. This is consistent with the more concentrated and longer gaze-tracking pattern in P2018. This suggests that a distinct and clear form of urban design could create a legible and imageable environment within developments (Lynch, 1960; Shushan et al., 2016).

There were only minor differences in the estimated height, number of buildings, and the distance travelled between the two planning phases. Although perceptions of the regulatory indices were not significantly different, both groups underestimated these indices in the VE. This might be explained by the gaze pattern of the participants, as they were primarily focused on the lower parts, thus not realising the height of the buildings. A number of studies have also highlighted misperceptions of scale in digital visualisations (Watzek & Ellsworth, 1994; Willis et al., 2009).

Therefore, one needs to be cautious when transferring experimental results using virtual representations, such as a head-mounted VR device, directly into the real world.

In both the SDS evaluation and spatial knowledge tests of regulatory devices, the personal differences between the two planning phases were slight. There were no statistically significant differences in spatial perception between male and female participants. This is consistent with the review of Coluccia & Louse (2004) concerning experiments on gender difference in spatial perception. Different to previous studies, although Chinese participants are more accustomed to high-rise clusters, the research findings do not support a positive relationship between one's cultural background and one's spatial perception of high-rises, as indicated by Davidoff (2012) and Palmer et al. (1990). In contrast to previous studies that identified the impact of planning expertise on spatial perception (Dupont et al., 2015; Paes et al., 2017), this experiment suggests that novice groups possessed comparable perceptual abilities to their more "expert" counterparts.

Previous research has demonstrated that participants with a higher level of education had a greater spatial processing ability (Hidayetoglu et al., 2010; Paes et al., 2017). In comparison, this research demonstrates that people without a university degree performed better than those with a university degree at landmark recall, scoring an average 5.2 points higher. This might be because more Chinese groups with a university degree (see Table 5-5) scored lower in the landmark recall test. Another potential reason could be that education level did not play a positive role in the participants' acquisition of spatial knowledge in this research context.

While the SDS results suggested that first-time VR users' perceptions of the technology may differ from those of experienced users, their performance on landmark and factual knowledge assessments was not significantly different. This shows the potential of VR to engage novices in planning and decision-making more widely.

Some of the discrepancies between previous test results and this experiment might be explained by the adopted approach. The complex immersive 3D environment instead of a 2D or 3D small-scale setting as often employed in previous studies. It could also be linked to the type of questions that were asked in the experiment, as the researchers primarily focused on survey and landmark knowledge. Testing spatial abilities through other dimensions of knowledge could lead to different responses.

5.2.5 Conclusion

This experiment was designed to investigate how the general public perceive the two planning phases of the Pazhou developments and the effectiveness of VR devices in aiding planning communication. Automated 3D gaze tracking adds objectivity to early research on the public's dynamic vision in urban environments. It resulted in a more nuanced understanding of participants' spatial perceptions and preferences, revealing areas of great attention and complexity for planning and design practise. Prior VR experience had a minimal impact on how participants perceived the environment; however, participants unanimously complimented the VR device, showing the possibility for future participatory planning processes to incorporate this tool. In terms of the SDS evaluation and spatial knowledge tests, the results indicate that there are only minor changes in perceptions of regulatory indicators between socio-demographic variables (gender, planning expertise, VR experience, and education level). This shows that the general people may play a

more significant part in the various stages of the planning and design process. Complex representations, which are often available in later planning phases, aid in landmark recall.

5.3 Chapter Summary

This chapter is contextualised within a high-rise urban district in Guangzhou. The study primarily focuses on the two planning phases of the project: *detailed regulatory planning* in 2015 and *detailed construction planning* in 2018. Through interviews and document analysis, this study figured out that the most influential stakeholders were the developers and designers, the chief urban designers, and government officials. The chief urban designers served as a platform for balancing public interests, examining building design, and providing professional support for governmental decision-making. Visualisation media at the planning formulation stage effectively aided stakeholder dialogues and evaluation of design alternatives. There was, however, little opportunity for the general public to provide feedback during planning formulation, and no advanced visualisation tools were used in the planning examination and approval stage.

As a result, the second experiment used automated 3D gaze-tracking and spatial knowledge tests to investigate how the public perceives the two planning phases (2015 and 2018) of the new high-rise urban development. The findings revealed minor differences in perceptions of regulatory indices between lay people and professionals. The VR device proves to be an equalised instrument for a variety of stakeholder groups. This suggests that the general public has the potential to play a greater role in various stages of the planning and design process using more interactive and immersive tools.

Chapter 6 - Community level-Micro-renewal of Puntoon Wuyue Village

This chapter introduces a community-level project – the urban renewal of the historic Puntoon Wuyue village in the Liwan District, Guangzhou (Figure 6-1). Urban renewal was recently introduced to China, and it is not specified in the statutory planning process, which can be briefly regarded as implementing a detailed regulatory plan (Figure 6-2). This case study is one of the first in Guangzhou to incorporate participatory planning methods into community rehabilitation, which conducts spatial interventions in areas with moderate levels of dilapidation while retaining the neighbourhood networks and historical layouts (Leaf, 1995; Yau & Ho, 2008). In Section 6.1, this research includes a systematic stakeholder analysis that addresses RQ1. Further, in Section 6.2, it presents the effectiveness of visualisation media used during the renewal process (RQ2) and the perceptions of various stakeholders regarding these tools (RQ3).

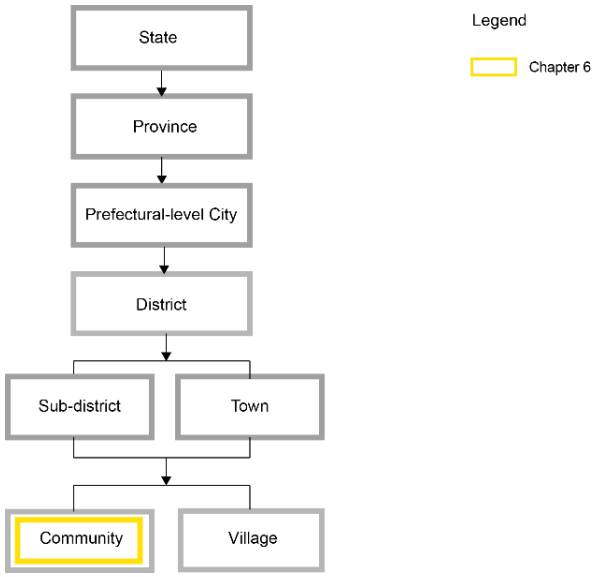


Figure 6-1 Planning scopes covered by the Puntoon Wuyue community renewal project

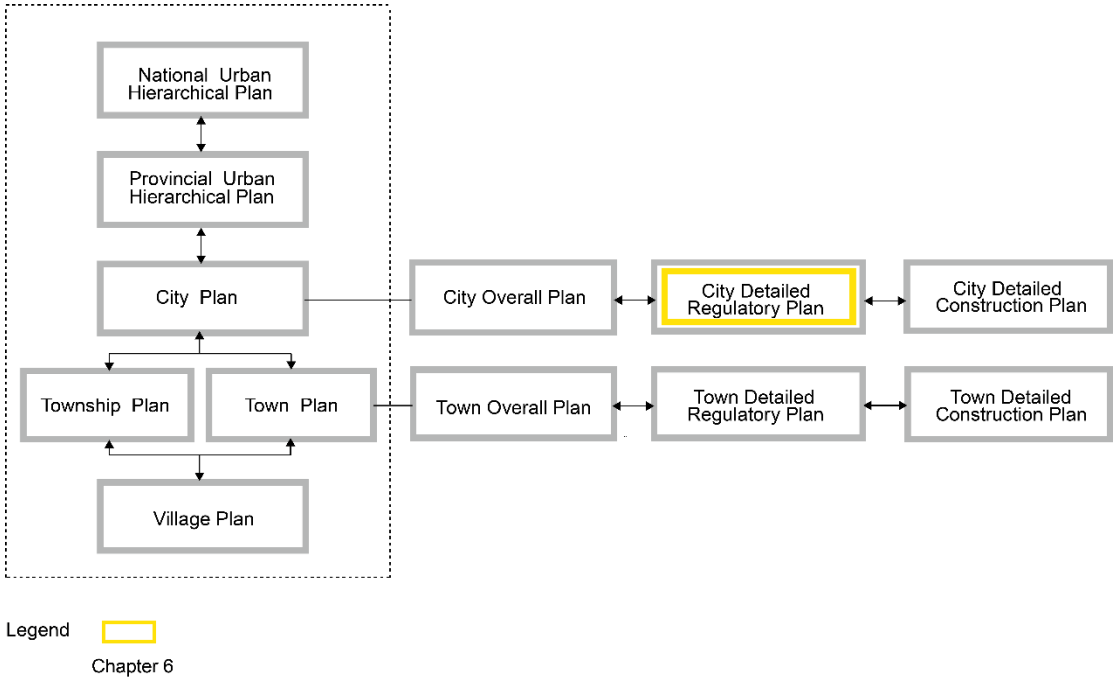


Figure 6-2 Planning information covered by the Puntoon Wuyue community renewal project

6.1 Stakeholder analysis

6.1.1 Research context

Puntoon Wuyue Village, with an area of 3.1 hectares, is situated in the western part of Guangzhou (see Figure 6-3a). “yue” (约) is the main residential unit in the Lingnan villages. There is no village head or village committee. Instead, local matters are co-addressed by residents from two clans, including “Li” and “Huang”. Although the basic layout of the village was established in the Qing dynasty, after years of housing demolition and resettlement, the historical settlement has gradually become a low-rent area for storage and wholesale operations (see Figure 6-3b). Many residents have been relocated nearby, with around 100 private households remaining in the area. Whether or not they still live in the area, local clan members share a deep attachment to the place, and clan

social cohesion is maintained through various cultural activities such as lion dances and dragon-boat parades.

(a) (b)

Figure 6-3 Site introduction

(a) Bird's eye view of the site; (b) Before renewal, the village preserves historical granite lanes yet with poor housing conditions; source: (a) from Guangzhou Daily news; (b) the author

In 2015, the Guangzhou city government published the *Measurement on City Renewal of Guangzhou* (2016) where it proposes two approaches for renewal: redevelopment and rehabilitation. The former involves the demolition of developments in run-down and dilapidated areas and their replacement with new types of land use; the latter approach, which has gained popularity in recent years, conducts spatial interventions in areas with moderate levels of dilapidation, while retaining the neighbourhood networks and historical layouts.

Due to its historical significance and the damage to the social network caused by earlier redevelopment, since 2016 the project has taken on a rehabilitation approach with governmental funds for renewal (Rui, 2019; Xu et al., 2017). It is recognised as one of the first in Guangzhou to use participatory approaches for community rehabilitation. For its rich historical impact and its

pioneering participatory approach for renewal, it is selected as one of several national pilot projects for community renewal. The broad social impact of the project and the diversity of stakeholders make this a good case study to understand its operation of stakeholder participation (RQ1), which is broken down to the following questions:

1. Who are the stakeholders?
2. What are their roles and characteristics?
3. How do stakeholders interact with each other?

The study looks at two phases of the project: Phase I (2016–2018) is dominated by governmental authorities and contracted designers responsible for the restoration of public housing and private accommodation. After renewal, public housing is managed by local governmental authorities; it has been rented out to retailers from various cultural industries. Phase II (2018–2020) consists of the improvement of public open spaces, pocket gardens and infrastructure facilities. Locals' needs are considered as the top priority. With the help of community planners, governmental sectors, news media and relevant professionals, various participatory activities take place, including focus groups, exhibitions, mutual collaboration committees, experimental constructions, and design competitions (see Figure 6-4).

(a) (b)

(c)

(d)

(e)

(f)

Figure 6-4 Selective scenes showing the various participatory activities

(a) focus group showing the restoration of an ancestral hall; (b) exhibition discussing future planning scenarios; (c) establishment of a mutual collaboration committee; (d) clan leader presenting his idea to an expert meeting; (e) experimental construction of a proposed gate; (f) voting in a design competition

Image source: a, c, e from Urban Elephant Architects + Design Laboratory; b, d from the author; f from Yanru Huang

6.1.2 Method

6.1.2.1 Methodological framework

Stakeholder analysis is a process to identify stakeholders and their interests as well as assess their influences and relationships (Brugha & Varvasovszky, 2000). As stipulated in Section 2.1.3, Reed et al. (2009) developed one well-received framework for conducting stakeholder analysis, which entails three stages: 1) identifying stakeholders, 2) differentiating and categorising stakeholders, and 3) investigating relationships between stakeholders.

The selection of stakeholder analytical methods depends on the research focus, the available resources of the researchers and the ways in which the stakeholders interact (Yang et al., 2011). In this case a combination of expert opinion, focus groups, semi-structured interviews, and document analysis were used to identify stakeholders (Prell et al., 2009; Reed et al., 2009). For stakeholder categorisation, following Ackermann and Eden (2011), Lienert et al. (2013) and Zhuang et al. (2019), an influence–interest matrix was used. Apart from asking about stakeholders' level of interest and influence, their levels of participation were also investigated, providing a more comprehensive way of understanding their characteristics.

As addressed in Section 2.1.3, whilst social network analysis is a frequently used approach for quantifying stakeholder interaction, it could be tedious and time-consuming for participants to fill in the surveys, especially when a large number of stakeholders are involved (Reed et al., 2009). Thus, I build on actor-linkage matrices, which are flexible for data collection (Biggs & Matsaert, 1999), to explore stakeholders' communication frequencies and relationships. The outputs from these matrices only offer a general pattern of stakeholder dynamics; they do not reveal the relationships between individuals' socio-demographic characteristics and the levels of their

participation and interaction. Statistical analyses using Non-parametric Mann–Whitney and Kruskal–Wallis tests in SPSS 25.0 were performed to quantitatively assess these relationships.

As shown in Figure 6-5, the methodological protocol for this study comprises three steps: (1) to identify stakeholders involved in the project through ethnographic observations, interviews and document analysis; (2) to categorise the identified stakeholders based on various characteristics, including influence, interest, and participation level; and (3) to explore the communication and interrelationship between stakeholders using actor-linkage matrices. These three steps refer back to the three research questions individually.

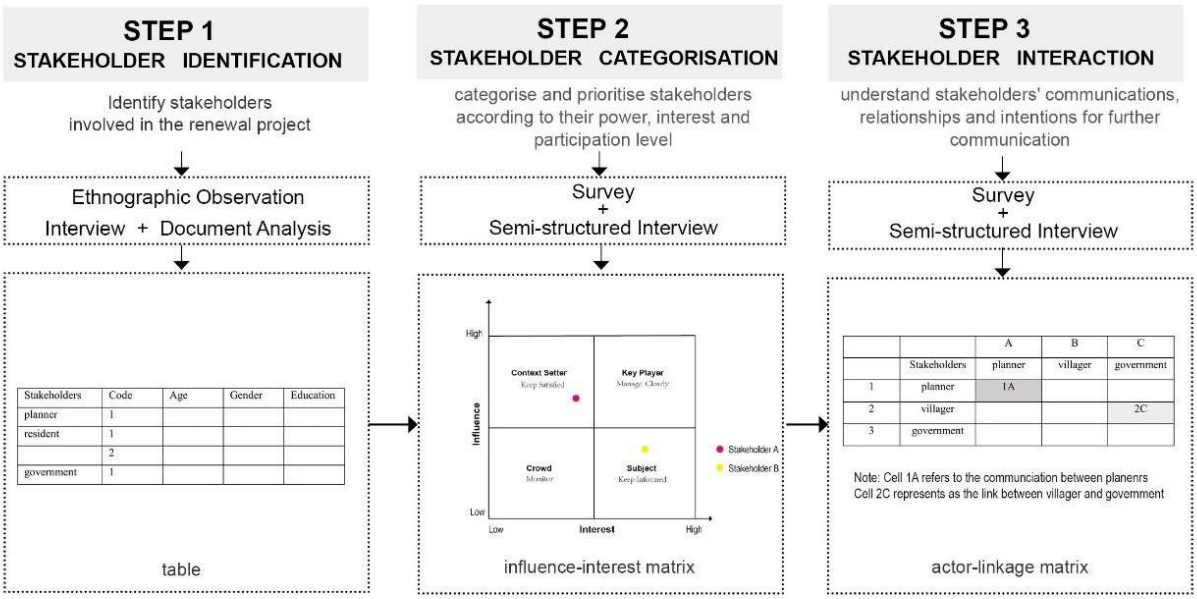


Figure 6-5 Methodological framework for the study

6.1.2.2 Data Collection and Analysis

Fieldwork was conducted twice a year (each period lasting 1-2 months) between November 2018 and October 2020, following different stages of the project development. The stakeholder identification involved participant observations and semi-structured interviews by engaging in

various participatory activities during the community renewal process. Meanwhile, document analysis was carried out via social media posts and online news stories to assist the researchers in staying abreast of the project development. Having gained a thorough understanding of the project and secured the trust of research participants, the researcher conducted formal surveys (see Appendix J) and interviews in October 2020 (towards the completion of the renewal project).

Step1: Stakeholder Identification

Considering the nature of the community renewal project, the geographical border of the village was used as the system boundary as it represents a discrete social (e.g., neighbourhood network), economic (e.g., business and development) and environmental (e.g., location of dwellings) system. In accordance with Reed et al.(2009), stakeholder identification was made through semi-structured interviews and ethnographic observation in seminars, expert meetings and daily observation during the fieldwork.

Stakeholder identification was an iterative process: more stakeholders were added as the project progressed. Project managers were consulted to verify the preliminary stakeholder list and suggest other stakeholder groups. Targeted stakeholder groups were approached online or offline for stakeholder categorisation, depending on their accessibility. Stakeholders who live or work in the village were visited on a household basis. This ensured that at least one representative from each household was invited to participate in the survey. Other stakeholder groups were approached through WeChat groups, snow-ball sampling methods and personal communication.

Step2: Stakeholder Categorisation

In the online/offline survey (see Appendix J), stakeholders were asked to (1) provide demographic information, including their age, gender, educational degree and stakeholder group; (2) identify their types of interests ("economic interests", "community benefits", "roles & responsibilities" and "self-fulfilment") and influences ("knowledge", "assets", "social skills" and "hierarchical position"), based on criteria derived from literature review (Hage et al., 2010; Zhuang et al., 2019); (3) rate their power and interest levels using a five-point Likert scale ranging from "none or minimal" to "very high"; and (4) characterise their participation in the community renewal project based on a spectrum including non-participation, information, consultation, collaboration, co-decision to empowerment (Arnstein, 1969; Luyet et al., 2012). For each question in the survey, participants were asked to provide justification for their choices: for instance, (1) Why do you think you have a high/low level of interest/influence in the project? (2) How did you get involved in the project?

The types of interests and influences of each stakeholder category were marked in a table, in accordance with Reed et al. (2009). Drawing upon Ackermann and Eden (2011), the levels of influence and interest were tabulated in an influence-interest matrix with each score serving as a coordinate in the graph. Different stakeholder groups were mapped using various symbols and their participation levels in the project were represented as a gradient of colours. Non-parametric Mann–Whitney and Kruskal–Wallis tests in SPSS 25.0 were used to examine the relationship between different stakeholder characteristics (gender, age, education degree and participation degree) and their levels of influence and interest (Field, 2013). Interview data were transcribed and analysed using NVivo 12.0 to complement the quantitative findings.

Step3: Stakeholder Interaction

In order to understand stakeholders' interrelationships, stakeholders were further asked to (1) state the stakeholder groups that they had communicated with in terms of the renewal project; (2) characterise their relationship with those groups, as cooperation, normal or conflict; and (3) identify the stakeholder groups that they wished to have more communication with. Semi-structured interviews were used to illustrate their choices: for example, (1) What do you often communicate with the particular group about? (2) What caused your conflicts with the particular group? (3) Why do you wish to interact with this particular group?

Building on Biggs and Matsaert (1999), the statistical results were tabulated in actor-linkage matrices to describe their interrelationships. As the stakeholder groups varied in size, the proportions of their answers within each group were used to indicate the intensity of relationships with others. As in Step 2, non-parametric Mann–Whitney and Kruskal–Wallis tests were used to examine the relationship between stakeholder demographic components (gender, age and education degree) and their contacts with others. Participants' interview data were analysed using NVivo 12.0.

6.1.3 Results

6.1.3.1 Stakeholder identification

Fourteen stakeholder groups from five categories were identified in Table 6-1. These include: (1) *in-situ* stakeholders, such as local residents (LR), tenants (TE), retailers (RE) and other citizens/tourists who visited the site (OC); (2) design professionals, including community planners (CP), designers of the project (DE), design competition participants (DCP), designers from the surrounding site (DS) and expert consultants (EC); (3) government officials at the local level

(GOL), district level (GOD) and city level (GOC); (4) news media (NM); and (5) construction team (CT). A total of 145 completed questionnaires were received, comprising around 25% of the total stakeholders, a return which was considered acceptable and is common in surveys (Akintoye, 2000). Their demographic characteristics are listed below: 82 were male and 63 were female. Age distribution was as follows: 31 were aged 18–30; 38 were aged 31–45; 45 were aged 46–60; 25 were aged 61–75; and 6 were 76 or older. 53 held an education level of middle school or below; 34 were educated to high school level; 51 held an undergraduate degree; and 7 were educated to master's level or higher. Due to the difficulty in approaching the elite groups, we failed to reach government officials at the city level (GOC) and expert consultants (EC). Their information was left out for future supplementation, yet comments from other stakeholders and online documents help infer their characteristics and interactions with others.

Table 6-1 Stakeholder groups approached in the study

Category	Stakeholder group	Abbr.	No.	Description
In-situ stakeholders (V)	Local residents	LR	68	Those who own private housing in the village or who used to live in the village and have moved to relocated housing while maintaining frequent contact with the villagers
	Tenants	TE	29	Those who rent housing from original residents
	Retailers	RE	18	Those who manage cultural industries (e.g. cafés and crafts) in the village by renting the retail units that have replaced the public housing after renewal
	Other citizens and tourists	OC	10	Those who come to the site regularly for exercise or other social activities
Professionals (P)	Design competition participants	DCP	3	Participants involved in the design competition for the renewal of the Sanguan Temple Square in the village
	Designer	DE	2	Those from the commissioned design company who are responsible for the planning and design of the renewal project
	Community planner	CP	2	Those from the commissioned design company who are responsible for bridging the dialogue between local people and other stakeholder groups
	Designer from the surrounding site	DS	1	Designer from the adjacent site, who negotiates with the case study stakeholders about the boundary design of the two projects
	Expert consultants	EC	0	Experts invited by government sectors who are in charge of project evaluation and making suggestions for planning and design in expert meetings
Government officials (G)	Local level	GOL	4	Sub-street committee (*Jiedao*) and urban management officers (*Chengguan*)
	District level	GOD	2	Government officials from the Bureau of Urban Renewal, Housing and Urban-Rural Development, and Cultural and Business Management at the district level
	City level	GOC	0	Relevant bureaus and/or government officials in charge of urban renewal at the city level
News media (N)	News media	NM	3	Journalists from the *Guangzhou Daily News*, *News Express*, and *Information Times*
Construction (C)	Leaders of the construction team	CT	3	Company who won the contract for the construction of the project

Note: the table was sorted according to total engaged participant numbers of each stakeholder category, and did not reflect the importance of each group.

6.1.3.2 Stakeholder categorisation

The influence and interests of each stakeholder are tabulated in Figure 6-6 and Table 6-2. Ackermann and Eden (2011) used the four quadrants in the grid to reflect the prominence and marginalisation of certain stakeholders. “Key player” is a stakeholder classification with high interest and influence levels, who should be engaged closely. “Subject”, while interested, has a lower influence level, and needs to be kept satisfied. “Context setters” show less interest, while exerting some power over the project, needing to be kept informed. “Crowd” exhibits neither interest in nor power to influence the project, thus are the least important.

All government officials (GOL, GOD) were in the key player quadrant. They played administrative and political roles in terms of the renewal project initiation, approval, maintenance, and management. The NM group were distributed between the key player and context setter quadrants. They collected news sources from the project. Their journalism ethics and social status facilitated them in reflecting public opinions to the upper-level government and disseminating information to the general public (interviewees NM–1 to –3). As reflected by NM–3, ‘[planners] don’t have power, and I have to use my voice to push relevant sectors for decision-making’. Professionals, including groups CP, DE, GCP, and DS were mostly located in the key player and subject quadrants. Since they did not have the final say in the project, some recognised themselves as less influential compared to the elite groups (interviewees CP–1, DCP–1, DCP–2). Among the government officials, news media and most professionals, job responsibilities, community benefits and self-fulfilment were three key concerns for their involvement.

In-situ stakeholders, particularly LR, were scattered in the four quadrants. The primary interests of LR related to community benefits such as cultural preservation and infrastructure. They exerted influence in providing background knowledge and feedback on the project. Despite also being the *in-situ* stakeholders, most of the participants from groups TE and OC were located in the crowd quadrant. Some considered themselves "outsiders of the village and project" and suggested that the researcher "ask the local people" (interviewees TE–8 to –10, OC–5). Group RE from cultural and creative industries engaged later in the project by renting the restored public housing from relevant government sectors. A consensus had been reached that the community environment had a positive impact on their management, and in turn, their engagement would contribute to the cultural atmosphere of the area (interviewees RE–1 to –18). The construction team implemented the project and made a profit from it; thus they also considered themselves in the key player quadrant.

There was a significant association between the quadrant that the stakeholder is situated in and their perceived participation level in the project (p= 0.000). Most stakeholders in the key player and context setter quadrants had higher participation levels, ranging from consultation to co-decision. Those in the crowd and subject quadrant were often just in the informed category or were not aware of the project. Male and females varied significantly in their level of influence (p= 0.000) despite sharing similar interest levels, with males scoring their level of influence higher than females (M_{male}= 2.4, M_{female} =1.7). Significant differences were also observed between various age groups in influence (p= 0.026) and interest (p= 0.030). Stakeholders aged 31–45 had the highest interest (M=3.2) and influence (M=2.4), followed by the age group between 61–75. The elderly (76+) exerted the least influence (M=1.0) and showed the least interest (M=1.7). People with differing education levels also showed significant variation in the two metrics. Those holding a

master's degree or above showed the highest influence and interest and contributed around 1.5 scores higher than those with a junior-level degree or lower.

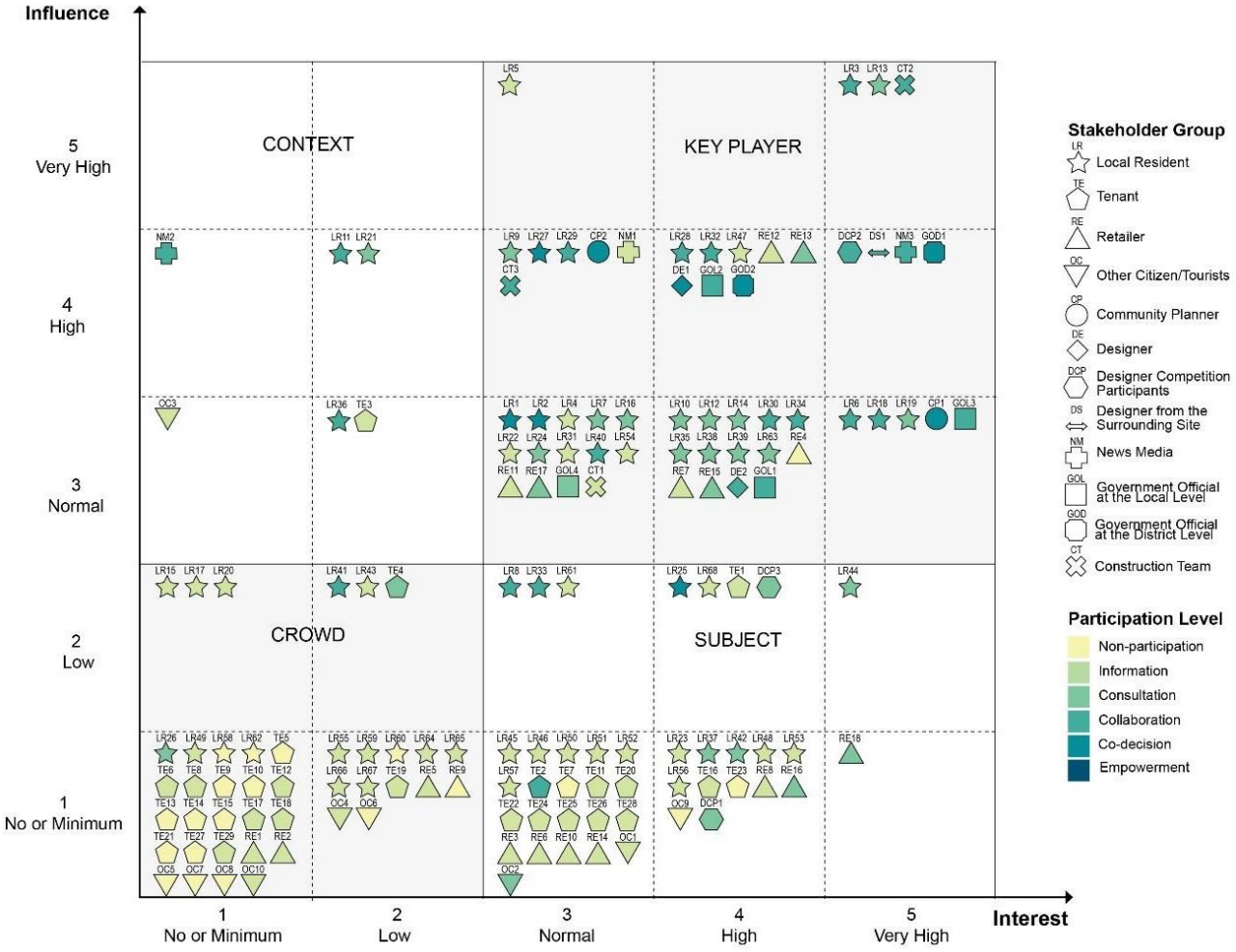


Figure 6-6 Influence-interest matrix in the community renewal project

Table 6-2 Stakeholder groups and their influence and interest in the project

Category		*In–situ* stakeholders				Professionals					Government officials			News media	Construction
Abbr.		LR	TE	RE	OC	DCP	DE	CP	DS	EC	GOL	GOD	GOC	NM	CT
Number of participants		68	29	18	10	3	2	2	1	0	4	2	0	3	3
Interest	Community benefits	X	X	X	X		X	X	X		X	X			
	Economic interest	X		X											X
	Roles and responsibilities						X	X	X		X	X		X	X
	Self-fulfilment	X				X	X	X	X			X			
Influence	Knowledge	X	X			X	X	X							
	Assets			X	X				X		X	X		X	X
	Social skills	X					X	X	X			X		X	
	Hierarchical position										X	X			

Note: "X" means stakeholders have identified interests and influences in relevant sectors

6.1.3.3 Stakeholder interaction

The actor linkage matrix in Figure 6-7 allows for the exploration of relations between different stakeholder groups. CP, LR, GOD, DE and NM had the highest number of two-way communications with other groups. However, the OC, GOC and EC groups were relatively marginalised, with a lower amount of contact with others. Some discrepancies were also noted. For instance, although groups NM, DE, DCP and DOC claimed to have communicated with groups TE and OC, these connections were not recognised by the latter two groups. Gender ($p = 0.022$) and education degree ($p < 0.001$) had a significant influence on stakeholders' connections with others. On average, males (M = 2) had a higher number of interactions than females (M=1.6), and stakeholders holding a master's degree or above (M = 8) had significantly more contacts than other education groups.

The proportion of people who had communication with other stakeholders indicates the degree of interaction between two groups. 74% of the LR group had communicated with people from the same group. In particular, some well-respected clan representatives were in charge of soliciting suggestions from other residents and mobilising the CP group (interviewees LR–3, 9, 7, 29). Some 31% of them had interacted with the CP group, followed by 12% with DE, 12% with GOD, and 10% with NM. The level of contact between LR and other stakeholder groups was relatively weak. A high proportion of RE (83%) reported having had contact with GOD for renting public housing and managing cultural industries in the village. NM participants had stronger connections with LR, TE, GOD and EC than with other groups. Professional groups, particularly CP and DE, had a high degree of communication with most of the other groups, 'for soliciting grassroots' ideas, connecting with other stakeholders, and responding to the higher-level authorities' (interviewees CP–1 to –2, DE–1).

Among government officials at different levels, GOD had stronger communication with other types of stakeholder groups than GOL and GOC; the vertical integration of these three groups was relatively weak. According to interviewees GOL–1 and GOL–2, the village does not have a village committee to coordinate information delivery and local matters; other local authorities were less actively involved because they did not consider the renewal process their obligation and thus were more focused on post-renewal management. Consequently, the project largely relied on members of the GOD group in charge of renewal and construction for preliminary review and negotiation with other district-level authorities (interviewee GOD–2). GOC oversaw guidance and approval; because of its hierarchical status, only two stakeholder groups (DE and GOD) could occasionally contact it.

Stakeholders		LR	TE	RE	OC	GOL	CT	DCP	NM	CP	DE	GOD	DS	EC	GOC
LR	*n=68*	0.74	0.09	0.03	0.01	0.01	0.04	0.07	0.10	0.31	0.12	0.12	0.00	0.01	0.00
TE	*n=29*	0.10	0.14	0.03	0.00	0.00	0.07	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
RE	*n=18*	0.17	0.00	0.11	0.00	0.06	0.00	0.00	0.00	0.06	0.00	0.83	0.00	0.00	0.00
OC	*n=10*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.00	0.10	0.00	0.00	0.00
GOL	*n=4*	0.75	0.25	0.00	0.00	0.75	0.25	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.00
CT	*n=3*	1.00	0.67	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	1.00	0.00	0.00	0.00
DCP	*n=3*	1.00	0.33	0.00	0.67	0.00	0.00	1.00	0.00	1.00	0.33	0.00	0.00	0.00	0.00
NM	*n=3*	1.00	1.00	0.00	0.67	0.33	0.33	0.33	0.67	0.67	0.67	1.00	0.33	1.00	0.33
CP	*n=2*	1.00	0.50	0.00	0.50	1.00	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	0.00
DE	*n=2*	1.00	0.50	0.00	0.50	0.50	0.50	0.00	1.00	1.00	1.00	0.50	0.50	0.50	0.50
GOD	*n=2*	0.50	0.50	0.50	0.50	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50
DS	*n=1*	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	0.00	0.00
EC	*n=0*														
GOC	*n=0*														

0.00 0.01~0.05 0.06~0.10 0.11~0.20 0.21~0.40 0.41~0.60 0.61~0.80 0.81~1.00

Figure 6-7 The proportion of people who had communication with others.

In each cell, colour from yellow to blue suggests the increased proportion of communication; "0" means no communication; the blank cells mean I need more information about the relationship (for EC and GOC).

The sparkline chart in Figure 6-8 shows the nature of relationship between stakeholders. Among those who had communication with other stakeholders, the major relationships between each group were cooperative and normal, suggesting a generally harmonious partnership in the renewal process. A small number of conflicts arose, which were expressed by some of the LR and T groups towards CT and the relevant members of the GOD group who were in charge of the construction project. These mainly resulted from the quality of construction, i.e. damage to private houses during the rehabilitation of public housing, and the quality of infrastructure including drainage system, pavements and pavilions in public open space (interviewees LR–50, LR–63, TE–2 and TE–24). One LR (interviewee LR–27) also expressed worries that the newly opened cultural and recreational industries by RE might affect local culture and livelihood (see Figure 6-9).

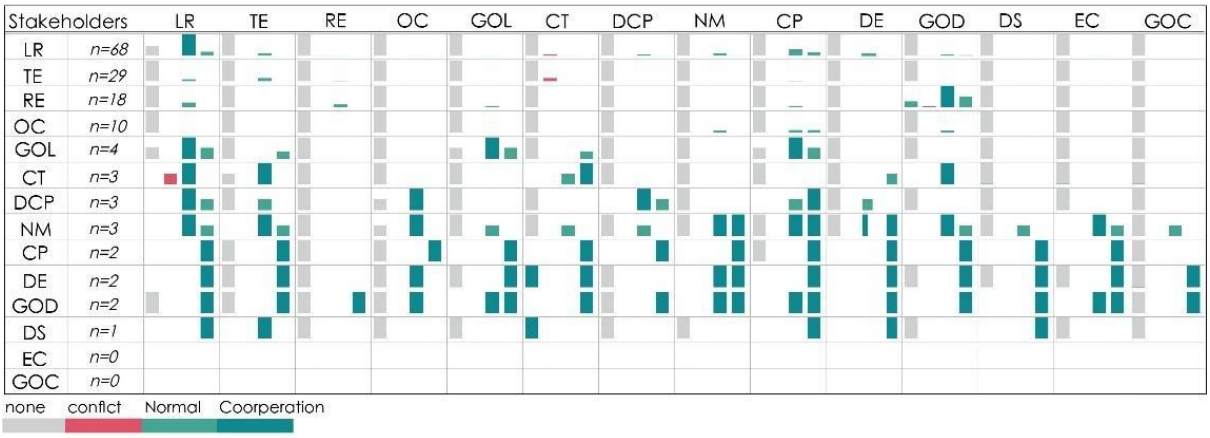


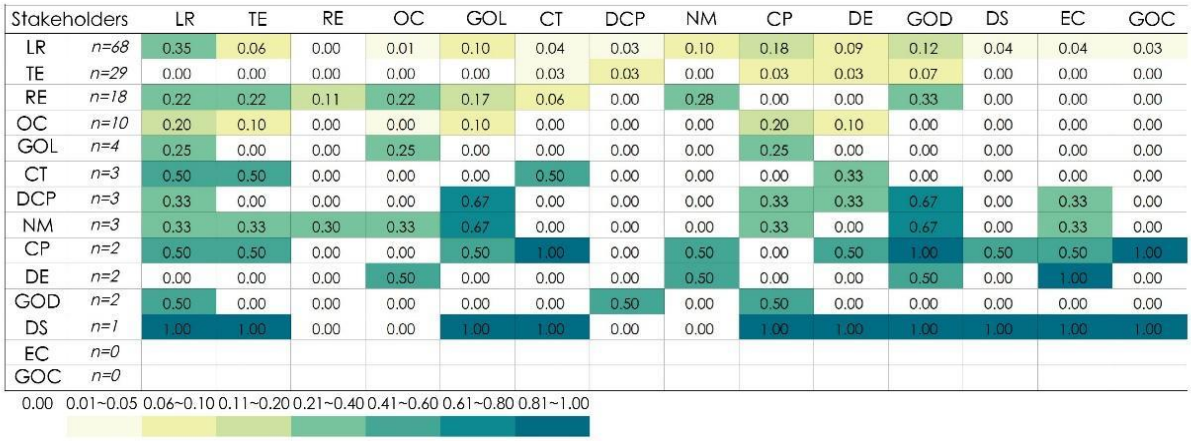
Figure 6-8 The relationship between stakeholder groups.

Note: relationship is represented by nocommunication (first column), conflict (second column), normal (third column) and cooperation (fourth column). GOC and CT were left out due to lack of data.

Figure 6-9 After renewal, coexistence of retailers (left, with wooden fence) and private housing (right, with clothes hanging)

Figure 6-10 illustrates stakeholders' wishes for further communication with others. Most people from the *in-situ* stakeholders, professionals, and news media, demonstrated strong willingness to communicate with government officials, particularly those at the district level. A two-way communication intention was also noticed in Group GOL and GOD towards LR and CP, for "a better understanding of the local concerns" (interviewee GOD–2). For economic interests and

wider social intention, Group RE hoped to establish more interaction with LR, OC and NM (interviewees RE–1, –4, –7). In contrast, Group TE and OC did not show a strong interest in linking with others, for being an outsider in the village (interviewees TE–27).



Stakeholders		LR	TE	RE	OC	GOL	CT	DCP	NM	CP	DE	GOD	DS	EC	GOC
LR	*n=68*	0.35	0.06	0.00	0.01	0.10	0.04	0.03	0.10	0.18	0.09	0.12	0.04	0.04	0.03
TE	*n=29*	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.03	0.03	0.07	0.00	0.00	0.00
RE	*n=18*	0.22	0.22	0.11	0.22	0.17	0.06	0.00	0.28	0.00	0.00	0.33	0.00	0.00	0.00
OC	*n=10*	0.20	0.10	0.00	0.00	0.10	0.00	0.00	0.00	0.20	0.10	0.00	0.00	0.00	0.00
GOL	*n=4*	0.25	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00
CT	*n=3*	0.50	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00
DCP	*n=3*	0.33	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.33	0.33	0.67	0.00	0.33	0.00
NM	*n=3*	0.33	0.33	0.30	0.33	0.67	0.00	0.00	0.00	0.33	0.00	0.67	0.00	0.33	0.00
CP	*n=2*	0.50	0.50	0.00	0.00	0.50	1.00	0.00	0.50	0.00	0.50	1.00	0.50	0.50	1.00
DE	*n=2*	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.50	0.00	1.00	0.00
GOD	*n=2*	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00
DS	*n=1*	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
EC	*n=0*														
GOC	*n=0*														

Figure 6-10 The intention of stakeholders to communicate with other stakeholder groups.

Note: in each cell, colour from yellow to dark blue suggests the increased proportion of stakeholders; "0" means no claimed communication; "blank" means I need more information about the relationship (for GOC and EC).

6.1.4 Discussion

6.1.4.1 Using participatory rehabilitation approach to enhance community interests

The focus of the project was on community benefits. In contrast with some redevelopment projects, which have been driven by individual economic interests, causing severe conflicts (Lee, 2016; Zhai & Ng, 2013), the interrelationships between stakeholder groups in this case were generally positive. These could be explained by the rehabilitation approach used in the project and the collective wish to better preserve traditional culture, as this safeguards original residents' social networks and cultural identities, which often leads to better socio-economic outcomes compared to redevelopment projects (Leaf, 1995). Additionally, the concerns and needs of stakeholders were

discussed through various participatory workshops earlier. These helped to eliminate potential disagreements compared to those reconstruction projects that are driven by developers (confirmed by interviewees CP–1, CP–2; LR–1 to –30, NM–2, NM–3 and GOD–2).

Nevertheless, as reflected in the project, neighbourhood renewal practices often come with construction quality issues. Construction companies won construction contracts by offering reduced rates in the tender process; due to time limitations, they had to pursue speed at the expense of quality (interviewees CT–2, CP–1). This shows that a supervision and responsibility mechanism should also be established for the final check and acceptance of the renewal project. The current study reflects stakeholders' general attitudes and interactions at the time of project completion. Acknowledging that stakeholder interrelationships evolve in a dynamic process, alongside the cultural industries operated by the RE group, a wide range of external actors may bring new stakeholder dynamics, which are of interest for future exploration.

6.1.4.2 Using brokers to enhance stakeholder communication

Strengthening the linkage between local residents and government officials was proposed by stakeholders from both sides, yet hindered by the current institutional context. Alternative ways to address these relatively separate elements were found through "brokers", including community planners, designers, local clan representatives, particular governmental sectors at the district level, and news media. The findings empirically support Liu and Xu (2018) and Hou (2019), who propose the "community planner mechanism" in the Chinese planning context, the variations of which have been successfully implemented worldwide. The linking role of news media has also been addressed by Happer and Philo (2013), as its social responsibility and professional ethics could enhance its credibility and confidence. In addition, the role of clan representatives in

connecting the LR and CP groups and the strong interaction between LR members was evident. This could be explained by the cohesion and high level of social organisation of clan culture.

6.1.4.3 Further need to include the marginalised group

Stakeholder categories were found to influence the self-rated power, interest, and participation level in the project. Elite groups such as government officials, news media and professionals generally claimed more power and a higher participation level compared to the *in-situ* stakeholders. This powerlessness of the grassroots can be explained by the political context, characterised by the country's inherited party-state domination and the remnants of its centralised system (Plummer & Taylor, 2013). Notably however, some *in-situ* stakeholders, particularly some well-respected representatives in the clans, also reported a relatively high participation level. This demonstrates a salient improvement on the situation reflected in earlier studies, suggesting a lack of public participation in Chinese planning practices (Enserink & Koppenjan, 2007; Shan & Yai, 2011).

Further probing into demographic differences suggested that female, less highly educated, elderly groups, tenants, and other citizens experienced the lowest degree of involvement and connection with other stakeholders in the project. This finding was consistent with Listerborn (2007), who reported a level of ignorance of underprivileged people with regard to regeneration policies and programmes. According to interviewees CP–2, LR–6, LR–27, and TE groups, this marginalisation could be explained by (1) the tradition in the local clan system that males are responsible for public affairs; (2) a lack of confidence to share opinions of the project within the elderly and less educated group;(3) time constraints; and (4) lack of interest. Therefore, three key recommendations are suggested to make the project more inclusive to these marginalised groups: first, access to the

neighbourhood network should be provided to them through various cultural and social activities; second, training and awareness-raising to promote tenant participation is required, in both political and ideological aspects; third, practitioners need to examine the motivators for the marginalised groups to participate and inspire their interests (Simmons & Birchall, 2007) .

6.1.5 Conclusion

This section provides a procedural framework to systematically understand stakeholder characteristics and interactions in the participatory community renewal process, complementing the descriptive approach adopted by previous studies. Combining the influence–interest grid, actor-linkage matrices and statistical methods can provide practical ways to prioritise stakeholders, assess interaction networks and suggest information flows that need strengthening or weakening. The case study is contextualised in an urban village with a unique history, a high level of social organisation and strong place attachment. As a pilot project for the renovation of old communities across the country, its successes and limitations yield recommendations for improving implementation of future community renewal practices across the country.

6.2 Stakeholder perception of visualisation media

6.2.1 Research context

A typical planning project undergoes inventory and analysis, planning and design, and decision-making processes before its final implementation. As stipulated in Section 2.4, many evaluation studies of visualisations concentrate on a particular point in time during the process. Although they effectively determine the potential or limitation of different tools, they fail to take into account the long-term perspective in the overall process (Bishop et al., 2013; Schroth et al., 2015). A

longitudinal study offers such a way to look back at past events and collect data showing the impact such events have had over a long period. Using a longitudinal examination of the Puntoon Wuyue community micro-renewal project, this section explores the effectiveness of different visualisation tools used in various planning stages (RQ2) and how stakeholders perceive these tools over time (RQ3).

The Sanguan Temple Square is a popular meeting place for the local people, where they gather and pursue cultural activities. In the second phase of urban renewal since 2018, community planners organise various focus groups to solicit local needs. A few improvements have been proposed and expanded upon through exhibitions and workshops during the design stage. Special attention was given to the reinstating of a gatehouse in the square. Using a range of media and with the help of a 1:1 physical model construction and a gate design competition, the final decision was approved in expert meetings. At the time of writing, the major part of the project has been implemented, while the gatehouse construction remains suspended due to a lack of funds (Lu et al., 2021).

Throughout the participatory process, seven types of visualisation tools were adopted. These include both analogue and digital media. Selective examples as used during the entire process are presented in Figure 6-11. Pictures of all visualisation tools used are listed in Appendix N.

a) An A0 board with sticky notes to solicit feedback on the site;
b) A series of A5 photographs documenting the history of the square;
c) A series of A4 paper maps showing the historical evolution of the site;
d) An A2 digital plan of the square design with detailed illustrations of key landmarks;
e) A 1:1 physical model of the proposed gatehouse (approximately 4 x 5 x 1 m);

f) 3D renderings showing the proposed gatehouse in the square for the design competition;

g) TV news informing the ongoing implementation of the project.

The photographs and maps (Figure 6-11b, -c, -g) were prepared using museum archives and private collections. The plan in Figure 6-11d was created by designers using Photoshop and CAD. 3D renderings as represented in Figure 6-11f were exported from selective perspectives (eye level and bird's-eye view) of gatehouse SketchUp models by different competition participants. Some visualisation tools enabled interaction with stakeholders. For instance, the large 1:1 physical model was pre-cut and arranged jointly by local people and planners (Figure 6-11e). Figure 6-11a shows that participants used sticky notes to express their concerns and vote for their favourite design (Lu et al., 2021).

Figure 6-11 Examples of visualisation media used during the participatory process

6.2.2 Method

To investigate stakeholder perceptions, triangulation approaches combining interviews and questionnaires were used, as suggested by Bishop (2013). Referring to Table 6-1, five stakeholder

categories were examined for data collection and analysis: in situ stakeholders (V), professionals (P), news media (N), construction team (C) and government officials (G). Between 2018 and 2020, the effects of visualisations were investigated using ethnographic observations and interviews with stakeholder representatives (V=10, P=3, N=2, C=1, G=1). Using NVivo 12 software, transcribed interviews were analysed through an inductive approach according to different phases of planning, and the perceived effects of visualisation media were aggregated into relevant codes (Braun & Clarke, 2006).

To get an overall picture of the performance of different visualisation tools and to support the qualitative interviews, surveys were conducted with 57 stakeholders (V=38, P=8, N=3, C=3, G=5), who have been involved in various planning phases (Inventory=28, Design=43, Decision-making=10, Implementation=16). They were identified through on-site ethnography studies. Their demographic data is as follows: 42 were male and 15 were female; 12 were aged 18–30, 16 were aged 31–45, 16 were aged 46–60 and 13 were aged 61 or above; 13 held an education level of middle school or below, 19 people were educated to high school level, 18 had an undergraduate degree, and 7 were educated at master's level or above. They were asked to evaluate the visualisation tools they had used in the project for ease of comprehension and helpfulness for discussion and state their ideal tools for each of the planning phases they participated in. Descriptive statistical analysis using SPSS 25.0 was used to show similarities or differences between the stakeholder groups (Lu et al., 2020).

6.2.3 Results

6.2.3.1 Perceived effects of visualisation tools throughout the process

Table 6-3 presents stakeholder responses to the effectiveness of visualisation tools that were coded in relation to the four planning stages: (1) Inventory and analysis, (2) Planning and design, (3) Decision-making, and (4) Implementation and maintenance.

Table 6-3 The coding framework in NVivo

Theme	Code
Inventory and analysis	Ice-breaking Cultural belonging Opinion solicitation Inspiration for design
Planning and design	Design communication Opinion solicitation Compare alternatives Social influence Culture promotion
Decision-making	Change political attitude Social influence Culture promotion
Implementation and maintenance	Social influence Culture promotion

In the inventory and analysis stage, in situ stakeholders (V) were initially opposed to the renewal project when approached, owning to long periods of housing demolition in their village. Analogue visualisations aided in building trust between Groups V and P. P1 recalled: “We made a physical model of the ancestral hall, [The local residents (Group V)] pointed at it and advised on areas that needed renovation using sticky notes. Later, they were much more open to us.” For many younger generations, the old photographs (Figure 6-11b) and paper maps (Figure 6-11c) have evoked the

hidden history of the village (noted by V3, V5, V7, V9). One example is illustrated by V3: “I was not aware that there was a river winding through the village, nor did I know about the cultivation of Puntoon Wuxiu (five kinds of water crops) in this area.” These have aroused their sense of cultural belonging, which later became the inspiration for the design, according to P3, “to restore local culture through different design features, such as pavements, stone lion sculptures, rebuilding the ancient bridge, and levelling the square for cultural activities.” (Lu et al., 2021)

During the planning and design stage, visualisation enabled active engagement and design communication. To promote the local culture, an exhibition showing the history and future of the site was initiated by some people from Groups V and P. 2D plans (Figure 6-11d) and physical models presented in the exhibition allowed visitors to “directly see the past and forthcoming future of the area” and “suggest their needs” (V4, V6, V8, V10). The reinstating of the historical gatehouse involves several government sectors, and its associated management problems have hindered its development. Therefore, Groups V and P worked together to build a 1:1 physical model (Figure 6-11e). According to V1, V2, P1, P2 and N1, the aims were twofold: “compare design alternatives and attract social attention through news reports and the on-site exhibition.”

Visualisations have had a significant effect in changing political attitudes during the decision-making process. The project initially failed to achieve approval due to disagreements between Groups G and P over the gate’s location. Following that, a design competition was held using SketchUp renderings, with participants asked to vote for their favourite design (Figure 6-11f). This successfully attracted a broad audience. According to one design competition participant (P5): “Many passers-by stopped by our exhibition and looked at different proposals; several journalists reported the event, one of whom even participated as a designer.” The social impacts greatly influenced the decision-making process. “The winning projects were against my proposal and I

have to compromise", said G1. P1 and P2 also observed changes in political behaviours after the competition: "G1 assisted us with the administrative process" and "Group G approved our design and complimented the competition voting as a collaboration example between designers and the general public".

Along with ongoing implementation, visualisation has had a broader socio-cultural impact. Many visitors to the square will stop and look at the photo exhibition (Figure 6-11b). This was reinforced by spontaneous behaviours by local residents and different types of publicity by news media (Figure 6-11g). N2: "I hope to raise awareness of the site, and promote the local culture and identity. This also has implications for other community renewal projects in Guangzhou." V5 explained his motivation for launching the village-based WeChat platform: "We hope to attract more attention to the village and spread our local culture…Several blogs went viral, garnering for much more readers than our account followers…"

6.2.3.2 Utility evaluation of visualisation tools

Table 6-4 summarises the various tools utilised during the participatory process. Analogue tools were largely used during the inventory stage. During the planning and design period, a blend of both types of tools were used, however, during the decision-making process, more digital visualisations were used. Both analogue and digital tools were used at the implementation and maintenance phase. Among the seven types of visualisation tools, 3D physical models, photographs and 3D digital modelling were seen by most participants, with sticky notes and news media being less frequently seen (Lu et al., 2021). The ease of comprehension of the visualisation tools was generally positively linked to their helpfulness for discussion. 3D physical models were

deemed the most beneficial for comprehension and discussion, followed by 3D digital modelling. In both metrics, paper maps were regarded as the least useful.

Table 6-4 Utility evaluation of visualisation tools in the Puntoon Wuyue case study

Availability during planning phases					Number of people have seen	Ease of comprehension			Helpfulness for discussion		
Category	PP1	PP2	PP3	PP4	Number	Low	Medium	High	Low	Medium	High
Sketch and sticky notes	X	X			22	9%	41%	50%	9%	32%	59%
Paper map	X	X			31	6%	61%	32%	10%	45%	45%
photo	X	X		X	34	0%	50%	50%	0%	44%	56%
Physical model	X	X	X		42	0%	26%	74%	0%	26%	74%
2D image		X	X	X	29	3%	48%	48%	3%	31%	66%
3D modelling		X	X		34	3%	38%	59%	3%	26%	71%
News media		X	X	X	27	0%	56%	44%	0%	33%	67%

0-25% 26-50% 51-100%

Note: PP1= inventory, PP2=planning and design, PP3=decision-making, PP4=implementation and maintenance; Light grey to dark grey indicates an increasingly stronger view regarding ease of comprehension or helpfulness for discussion.

Further, to explore the relationship between stakeholder category and the stakeholders' perception of different tools, the Spearman's correlation and Chi-square tests were applied where appropriate between different stakeholder variables (age, gender, education level and stakeholder types) and the score of the tools (ease of comprehension and helpfulness for discussion). Generally, gender did not impact stakeholders' perceptions of the digital visualisations. There were also no significant proportional differences in perceptions of analogue tools and news media amongst major stakeholder characteristics (age, gender, education level and stakeholder types).

Intergroup comparisons in Figure 6-12 show that Groups P and V perceive 2D digital images and 3D modelling differently. Among those who rated both tools with high ease of comprehension, the scores by Group P (75%, 78%) outperformed Group V (35%, 36%). Age differences also influenced the perception of digital imagery. More than 60% of those aged 18–30 considered them to be easy to comprehend and helpful for discussion while only 20% of those aged 61+ agreed. Education level was found to have an effect on how digital visualisation tools are perceived. Those with an undergraduate degree or above felt more at ease using digital tools than those at junior school level or below.

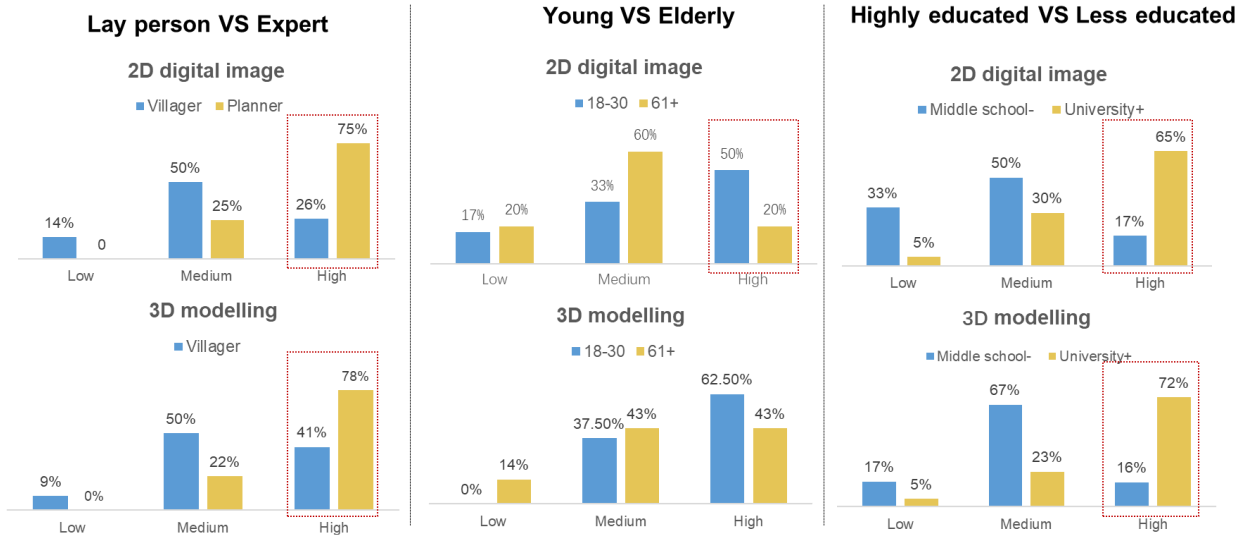
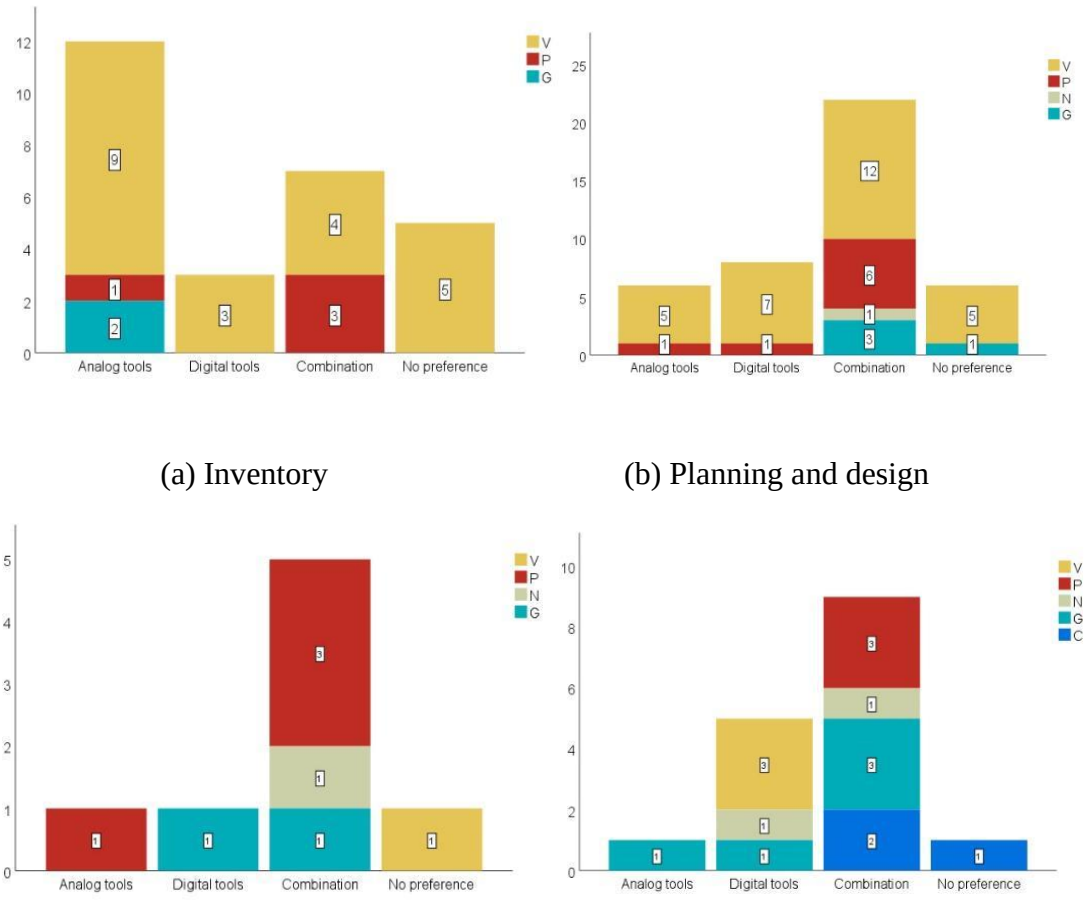


Figure 6-12 Intergroup comparison between stakeholder characters and their perception of varied visualisation tools.

Stakeholders were asked to specify their preferred visualisation tools for planning communication at each phase they were involved. Figure 6-13 suggests that the preferences of major stakeholders (Group V, NM and G) shifted from using analogue tools during the inventory stage to integrating analogue and digital devices as the project advanced, which corresponded to the observed use patterns (Table 6-4). Group P preferred to use both tools simultaneously throughout the process. Figure 6-14a shows that the majority of stakeholders prefer 3D physical models out of all the

analogue tools. Regarding digital visualisation tools, stakeholders preferred 3D and more advanced technology (Figure 6-14b), notably among younger generations and those with a higher education degree.

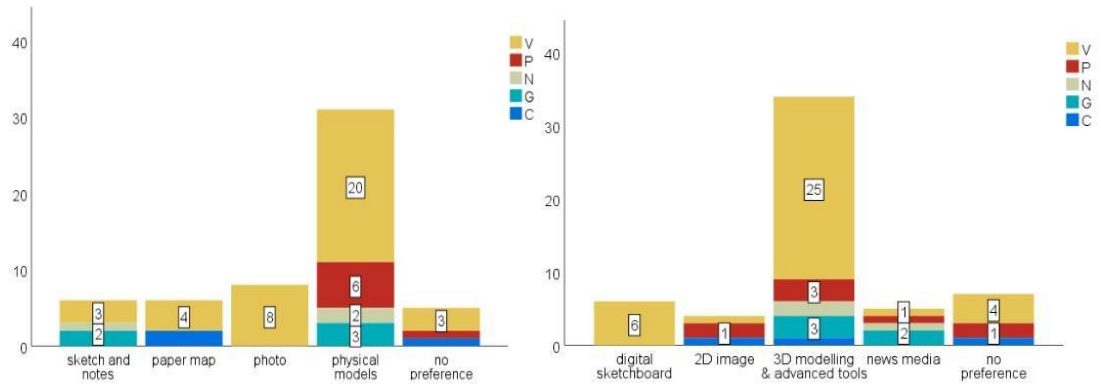


(a) Inventory (b) Planning and design

(c) Decision-making (d) Implementation and maintenance

Figure 6-13 Stacked bar count of stakeholders' preferences for visualisation tools at different planning phases.

(a) inventory; (b) planning and design; (c) decision-making; (d) implementation and maintenance



(a) Favourite analogue tools (b) Favourite digital tools

Figure 6-14 Stacked bar count of stakeholders' preferences for visualisation tools.
(a) favourite analogue tools; (b) favourite digital tools.

6.2.4 Discussion

The interviews have demonstrated the effectiveness of visualisations for information and communication during the planning process, which is consistent with earlier studies (Hehl-Lange & Lange, 2017; Wissen Hayek, 2011). Visualisation tools with larger dimensions, such as photo exhibitions, design competitions and a 1:1 physical model (Figure 6-11b, -e and -f), were shown to elicit broader social attention. This supports the findings of Lu et al. (2020), who discovered that landscape visualisations with larger dimensions are more likely to attract and maintain people's attention. This growth in social awareness aided in the transformation of political attitudes. The findings align with Schroth et al. (2015) where exposure to visualisations resulted in changes in governmental policy and operations.

Notably, the effects of visualisation on enhanced cultural identity were consistent at various stages, indicating that analogue and digital tools could serve as bridges to increase cultural awareness via both intangible elements and material forms. The results are consistent with those of Hehl-Lange

and Lange (2017), who found that participants related their memories and experiences to visualisations. In usability evaluations and preferred items, both analogue or digital 3D visualisation have demonstrated advantages over 2D representation. This is supported by the participants' ratings of various visualisation tools in the workshop experiment by Gill et al. (2013), which could be explained by the fact that 3D visualisations allow viewing the proposed design from multiple perspectives (Lange & Bishop, 2005).

Generally, disparities in facilitating comprehension and discussion were found amongst stakeholders in the evaluation of digital images and 3D modelling. These were evident between lay people and experts, the highly educated and less educated, and the young and the old. This is in line with previous study that experts differ from novices or lay people in processing image contents (Dupont et al., 2015). Furthermore, it validates Schroth et al. (2015), who also noticed the difficulties of the elderly in comprehending digital technologies.

6.2.5 Conclusion

This section has examined the use of analogue and digital visualisation tools throughout the community renewal project. It provides implications regarding when and how various tools could be tailored to meet different purposes in participatory settings. Age, planning expertise, and level of education were found to influence stakeholder perception of particular digital visualisations. However, stakeholders demonstrated little difference in their perceptions of analogue tools. The findings suggest that a combination of analogue and digital visualisation throughout the participatory process may best suit diverse stakeholders' needs and cater to a wider audience. This may serve as a basis for developing more detailed visualisation guidelines for stakeholder

engagement. In future research, advanced visualisation techniques that enable on-site visualisation are anticipated to play an increasingly important role in visualisation and stakeholder involvement.

6.3 Chapter Summary

This chapter reviews stakeholder participation and visualisation in a community level renewal project. Building on influence-interest, actor-linkage tools, and statistical analysis, it investigates stakeholder characteristics and interaction. The results highlight the effectiveness of holding participatory activities and establishing common interests in building positive stakeholder relationships. Furthermore, they show the importance of brokers, including community planners, village representatives and news media, in enhancing "vertical" integration of the grassroots level with governmental bodies. However, the results also reveal a marginalisation of the elderly, females, less educated people, and other less influential groups, calling for more inclusive participation.

In the second section, using questionnaires and semi-structured interviews, the study examines stakeholder perception of visualisation tools used throughout the participatory renewal process of the Sanguan Temple Square in the Puntoon Wuyue Village. These include analogue tools (sticky notes, photographs, paper maps, 3D physical models), digital visualisations (2D digital images, 3D modelling) and news coverage. The longitudinal impacts of different visualisations were observed, ranging from information and communication to social, cultural, and political influences on public awareness, cultural rehabilitation, and political attitudes. 3D physical models and 3D modelling were considered the most useful in terms of aiding comprehension and discussion. Age, level of education, and planning expertise were found to influence stakeholder perception of 2D

digital images and 3D digital models. However, stakeholder characteristics do not affect their perception of analogue tools. The findings suggest using a combination of analogue and digital visualisations overall suits stakeholders' needs best.

Chapter 7 - Conclusion and outlook

The final chapter begins with a summary of the research background and the key findings reflecting the research aim and questions. It compares and discusses the similarities and differences between institutional arrangements and local practices concerning the operation of stakeholder participation, the use of visualisation media, and the effects of stakeholder characteristics and visualisation tools on stakeholder perception. It proposes recommendations for policymakers, urban planning exhibition hall (UPEH) practitioners, planning professionals, and the general public to promote better utilisation of visualisation media for participatory planning practices. Finally, it outlines the limitations of the research and the scope for future research.

7.1 Introduction

This research takes a multi-scale perspective on stakeholder participation and visualisation in Chinese urban planning processes. A framework analysis first examines stakeholder participation and the use of visualisation media in the legal documents. Following on, three case studies at different planning levels in the Pearl River Delta (PRD) are examined. These comprise urban planning exhibition halls at the provincial level, the Pazhou Internet Innovation Cluster at the subdistrict level, and the Puntoon Wuyue Village renewal project at the community level.

7.2 Research questions and main findings

The research proposes three main questions whose results are illustrated in Table 7-1 and explained in detail as follows:

1. **How does stakeholder participation work, and how effective is it at different levels of statutory planning?**

Chapter 3 establishes that stakeholder participation is part of the statutory planning process during planning formulation, revision, implementation, and supervision. However, the public is generally only informed after planning has already been finalised and notified after planning has been approved, with little room for them to provide inputs and get their opinions adopted.

Chapter 4 shows that, despite a significant increase in the participants' knowledge and participation level after visiting the Guangzhou UPEH, they were provided with limited opportunities to provide feedback. Some participants were suspicious regarding the relationship between the state and civil society and they lacked confidence in their right and ability to influence decision-making.

Chapter 5 describes that, active participants in the subdistrict level projects are professionals and government authorities, and the general public is only consulted before planning approval through governmental websites, with limited opportunity for providing feedback in the earlier design period. Throughout the planning process, chief urban designers serve as brokers for balancing the interests of land developers, relevant design institutes, and government authorities. During planning implementation, onsite publicity was not executed by following regulations precisely; nor did it invite public engagement.

Chapter 6 presents a participatory community renewal project in which positive stakeholder relationships were maintained. Brokers, including community planners, village representatives and news media enhanced the integration of the grassroots level with governmental bodies.

Marginalisation of the elderly, females, less educated people, and other less influential groups was revealed.

2. How effective are the different visualisation media used to communicate planning proposals throughout the statutory process?

Statutory planning regulations require using text and 2D images (plans) for planning communication at most planning scales. When it comes to the detailed regulatory planning of critical projects in the city or town, visualisation media may include 3D perspective renderings. These conventional tools may fail to be well understood by the lay people due to the lack of interactivity and immersion.

Apart from the conventional tools such as text and 2D plans, UPEHs at the provincial level offer a range of state-of-the-art visualisation media, including largescale physical models, multichannel digital sand table models, animation, 4D visualisation, VR, and AR. Through these tools, stakeholders significantly enhanced their knowledge of urban planning in Guangzhou.

At the subdistrict level, visualisation media used during the formulation of detailed construction planning included text, 2D plans, 3D physical models and 3D rendering. They helped to facilitate planning communication, design evaluation, and changes in stakeholder opinions. However, planning communication was only realised on governmental websites through text and 2D plans of the proposed development during the planning examination and approval; the planning implementation stage reveals insufficient planning information, with only one site out of 17 ongoing constructions offering an ideal rendering image of the development.

At the community level, analogue tools (sticky notes, photographs, paper maps, 3D physical models), digital visualisations (2D digital images, 3D sketch up modelling) and news coverage were used in the participatory process. These tools aid in the dissemination of knowledge and communication, cultural rehabilitation, social awareness enhancement, and the modification of political attitudes.

3. **How do stakeholder characteristics and visualisation media vary and interact at different scales of planning practices?**

4.

At the provincial level, stakeholders' personal, social, and physical factors did not significantly affect changes in their self-assessment and knowledge tests. However, participants' prior knowledge, education level and visit length were found to influence their acquisition of specific dimensions of knowledge. In general, no matter their characteristics, stakeholders showed a preference for multimedia over 2D representations. The size of visualisation tools and the scale of planning information had a significant impact on stakeholder perception.

At the subdistrict level, the stakeholder category significantly affected their participation level in urban development. In the VR experiment, participants' semantic differential scale (SDS) evaluation and spatial knowledge testing revealed marginal differences between participants' sociodemographic characteristics in perceiving regulatory indices such as height, distance, and number of buildings. Regarding perceptions of visualisation tools, although first time VR users might differ from experienced ones in their attitudes, their performances in the landmark and factual knowledge tests were not significantly different.

At the community level, the government authorities and professionals had a higher participation level than the in-situ stakeholders such as residents and tenants. The results revealed marginalisation of the elderly, females, less educated people, and other less influential groups. Regarding the perception of visualisation media, age, level of education, and planning expertise affected stakeholder perception of 2D digital images and 3D digital models. However, stakeholder characteristics did not affect their perception of analogue tools.

Table 7-1 Descriptive comparisons of the case studies

Planning level	Stakeholder participation	Visualisation media	Stakeholder characteristic (SC) interaction with visualisation media(VM) in stakeholder perception
Statutory planning regulations	Required during planning formulation, modification, implementation and supervision	Text	NA
		2D map	
		3D visualisation	
		UPEH utilising various visualisation tools	
Provincial level: Urban planning exhibition hall	Stakeholders are mainly provided with planning information after planning approval, with limited opportunity to provide feedback	Text	SC: All stakeholders' knowledge improves significantly VM: Size, media type and planning scale affect public perception
		2D plan, 2D map	
		3D physical model, perspective rendering, video	
		4D visualisation	
		VR and AR	
Subdistrict level: Pazhou Internet Innovation Cluster	The elite group is actively involved; the regional chief planner serves as the mediator; the general public has limited opportunity to participate	Text	SC: No significant difference between various stakeholders in spatial perception VM: VR is an equalised tool for stakeholders
		2D plan	
		3D perspective rendering, 3D physical model	
Community level: Puntoon Wuyue Village	Elite groups have higher participation levels compared with the public; community planners, clan representatives and news media serve as brokers to bridge dialogues	Text	SC: Education level, age and planning expertise affect stakeholder perception of digital visualisation. VM: 3D visualisation is preferred over 2D visualisation
		2D plan, 2D map, photo	
		3D physical model, 3D rendering images	
		news media	

7.3 Discussion

7.3.1 Stakeholder participation and effectiveness at different planning levels

This research provides a multiscale view of stakeholder participation in the contemporary Chinese planning process by examining institutional arrangements and planning practices. Unlike the commonly held belief about a minimum level of stakeholder participation (Enserink & Koppenjan, 2007; Xie et al., 2017; Zhuang et al., 2019), more dynamic stakeholder interaction was witnessed in the case studies. In particular, the participation level of the general public decreases at higher planning levels in the governance hierarchy. This reflects a coexistence between top-down governance and bottom-up participation as a result of marketisation, local participation and political decentralisation (Zhao, 2015).

The long-established social, economic, and political contexts may prevent government authorities from taking direct responsibility for a range of public needs and result in a lack of public awareness about providing feedback. A milder and more practical way is to use brokers, as revealed by the chief urban designers at the subdistrict level and community planners at the community level, to convey or represent the public interests. Central to these phenomena, however, is the need to identify who and what constitutes the public, what the public interests are (Maidment, 2015) and whether these brokers could adequately account for public interests (Howe, 1992). This raises concerns about balancing professional discretion versus detached neutrality in deciding design and planning (Royal town planning institute, 2019).

7.3.2 Use and effectiveness of visualisation media across the planning process

The three case studies demonstrated the efficacy of visualisation media regarding planning communication, stakeholder awareness, cultural rehabilitation, and influencing political attitudes. This is consistent with Schroth et al.(2015) and Wissen Hayek (2011). Together these demonstrate that a wider and wiser usage of visualisation media could benefit participatory planning across different cultural contexts. Generally, the complexity of visualisation media increases with planning at larger geographic scales. According to Walker (2017) and Jiang (2019), the use of visualisation media is often affected by manpower, available budgets and the desired effects. For instance, for city branding purposes and attracting visitor attention, UPEHs used various state-of-the-art visualisation tools; due to financial and technical constraints, and to cater to the local needs, the community renewal project used basic tools that allow hands-on interaction between stakeholders.

The disparity between the decline in stakeholder participation and the increased variety of visualisation media at the higher planning scale raises several questions: Why invest heavily in planning communication while stakeholder feedback is hardly obtained? On a tight budget, how can local-level practice gain more access to visualisation tools? In an ideal world, the UPEHs should make full use of their media to enhance participation; on the other hand, visualisation resources in the UPEHs could be allocated more wisely, such as providing venues and devices for some ongoing local-level projects with limited access to these. Meanwhile, since the implementation of the sub-district level case study insufficiently addresses the legal requirements, the need for measuring regulatory performance of publicity is highlighted.

7.3.3 Impact of stakeholder characteristics and visualisation media on planning perception

Previous studies showed that the general public differs from the professionals in perceiving and processing planning information (Dalholm & Mitchell, 1996; Dupont et al., 2015; Qiu et al., 2013). Contrary to their findings, this research generally revealed no significant differences between various stakeholder groups in their cognitive and behavioural responses to the virtual environments. This demonstrates that they should play a more substantial role in the planning and decision-making process. In all the case studies, however, the elderly, females, and less educated people were less actively involved in planning. These marginalised groups have been reported globally in both democratic (Jackie, 2013; Lee et al., 2014) and less developed areas (Liu & Lou, 2010), calling for a more inclusive participatory approach in planning practices.

The physical features of visualisation tools, such as size and type, were found to have a substantial impact on stakeholder perception. This fills the previous research gap in which visualisation studies ignore the impact of the characteristics of the visualisations (Metze, 2020). The scope of this work extends previous studies on the effect of visualisation tools in workshop environments (Schroth et al., 2015; Wissen Hayek et al., 2008) to a larger-sphere social context. Although the more advanced visualisation tools generally gained popularity against conventional tools, as shown in the three case studies, the more technical and cutting-edge visualisation media are not necessarily better. In the local-level case study, the elderly, laypeople and less educated people all showed certain difficulty understanding digital techniques, suggesting a combination of analogue and digital devices would suit diverse stakeholder needs, which is in line with Al-kodmany (2002) and Gill et al. (2013).

7.4 Contribution to knowledge

This research provides a multi-scale perspective on stakeholder participation and visualisation in the contemporary Chinese planning process. The findings augment existing theoretical knowledge towards the improvement of planning policies and practices. The study:

- is one of the most comprehensive investigations of the institutional arrangements and operational management of stakeholder participation and visualisation in contemporary Chinese planning;
- uses a mixed approach to comprehensively analyse newly emerging participatory mechanisms in China, such as community planners and chief urban designers, contributing to the dialogue between public and government authorities;
- is the first to examine the effectiveness of UPEHs through a mixed-method approach, providing insights which may be helpful in the development of guidance for professionals involved in the design and delivery of UPEHs;
- extends the existing research on public's cognitive, affective, and behavioural perceptions of visualisations in the planning process, including all stages from workshop settings to real-world planning, and both time-specific and longitudinal planning processes;
- explores how physical dimensions of visualisation and stakeholder characteristics influence stakeholder perceptions of planning, providing recommendations for the optimisation of visualisation media to suit diverse stakeholder needs.

7.5 Implications of the research

Towards improved stakeholder participation and use of visualisation in Chinese planning processes, the findings of this research are used to produce a set of recommendations for policy

and practice, including for policymakers, UPEH practitioners, planning professionals, and the general public.

7.5.1 Policy makers

The research findings highlight the inadequacies of existing planning regulations regarding stakeholder participation, providing an evidence base for policy makers to undertake radical changes, encouraging grassroots participation in the earlier planning stages by using more dynamic visualisation media. To achieve this, governmental authorities need to enhance dialogue with the general public and strengthen capacity building in local governance to meet public needs. Establishing a "broker" mechanism might be one interim step to increase public–government interaction. Meanwhile, at the implementation stage, poor compliance with legal regulations regarding on-site planning publicity highlights the need for a supervision mechanism to facilitate stakeholder participation.

7.5.2 UPEH practitioners

Professionals involved in the design and delivery of planning exhibitions should consider the impact of physical displays (planning content, media category, media size) and user characteristics (education level and prior knowledge) on public perceptions, adjusting curatorship to better suit diverse needs. Meanwhile, the inadequacy of the Guangzhou UPEH in facilitating stakeholder participation highlights the importance of initiating participatory activities that allow more effective stakeholder inputs. For example, UPEHs could collaborate with government authorities and interact with on-going local practices in the holding of workshops, seminars, and temporary exhibitions to assess stakeholder opinions.

7.5.3 Planning and design professionals

Subdistrict and community level practices have highlighted the role of community planners and chief urban designers in facilitating dialogue between governmental authorities and the general public. Planners should be promoted as gatekeepers in future planning processes to enhance dialogue while balancing professional discretion and stakeholder interests. They should use visualisation tools tailored to different stakeholder needs to stimulate stakeholder participation. The study shows the potential of using VR and gaze-tracking to understand human–environment interaction, allowing for more pedestrian-friendly planning and design.

7.5.4 The general public

Results have shown that stakeholder type, education level, gender, willingness to participate, and stake in the project can affect engagement. Many laypeople are unconcerned about planning because they either lack the expertise and time to participate in the process or because they think their voices will not be heeded by decision-makers. Therefore, it is essential to reach out to members of the public through various campaigns to raise their self-awareness in participation, help them to understand their rights in civil society, and actively to access feedback channels in the planning process.

7.6 Limitations and outlook

The research is limited in several aspects. This section provides recommendations on how future research can build upon the present study while addressing these limitations.

(1) Case study approach at different planning scales

This research focuses on case studies at provincial, subdistrict, and community level in urban areas in the Pearl River Delta, taken as a representative of the most developed Chinese economic regions. Due to the context-dependent nature of the case study approach, methods and levels of stakeholder participation are dependent on the local social, cultural, political, and environmental situation (Plummer & Taylor, 2013). Thus, findings may be pertinent to particular phenomena without providing a scientific basis for generalisation (Yin, 2013). Future research could explore participatory planning practices in various geographical, economic, and political contexts to get a more comprehensive picture of stakeholder participation in China.

(2) Outsider researcher vs. insider researcher

Insider and outsider perspectives both commonly play a role in fieldwork. Insider researchers share characteristics in common with research participants, which helps to enhance trust and openness, promoting data collection; however, researcher perceptions might also be biased as a result (Dwyer & Buckle, 2009). In an outsider perspective which was the approach adopted here, the researchers retain neutrality in their attitude towards the stakeholder network; however, they may then encounter difficulties reaching specific stakeholder groups. In future research, establishing a status between insider and outsider might help the researcher engage more closely with planning projects and thus to gain deeper insights.

(3) The limitation of sample size

The sample size in this research was affected by time constraints, the nature of the case study and the accessibility of stakeholders. As such, more stakeholders were involved at a lower governance hierarchy. A small sample size may reduce research power and enhance margin of error. For

example, in the subdistrict case study, lack of participants in certain demographic groups (i.e. age) prevents an assessment of the impact of these characteristics on stakeholder perception. Future triangulation methods, such as the combination of in-depth qualitative studies and quantitative analysis, could be jointly used to investigate stakeholder feedback.

(5) Preparation and evaluation of visualisation media

The visualisation tools for planning communication were chosen by professionals involved in the case studies. Thus, the researcher had no control over their types, contents, or location. Unlike in controlled experiments, where participants can be selectively exposed to the media under investigation, the effectiveness of visualisation tools was evaluated holistically based on a pool of different media. This acknowledges potential external influences on stakeholder perceptions, such as social and physical surroundings. The efficacy of more advanced visualisation tools permitting on-site participation remains to be examined.

(6) Ethics of visualisation content

A further concern lies in the ethics of visualisation. While visualisations can be informative, they can also be manipulated to convey information following the creator's bias. For example, the creator could choose the location of viewpoints and use more advanced ICT solutions to generate 'wow' effects. This can cause a severe bias in participation processes since proponents might utilise the visualisation in a dangerous way, resulting in poor urban planning decisions. The gained awareness expressed by participants following the process, in this perspective, can be easily manipulated. As each style of visualisation has the capacity to persuade, it is important to understand how to avoid using them in a biased way. To address these issues, Sheppard (2001)

proposes six general principles for enhancing the legitimacy of visualisation presentation: accuracy, representativeness, visual clarity, interest, legitimacy and access to visual information. Future work can investigate how preparers and presenters of visualisation should apply these principles in real-world planning practices.

7.7 Conclusion

This thesis is one of the first studies to take a multi-scale perspective on stakeholder participation and visualisation in the Chinese planning process. In contrast to the established notion that there is no proper stakeholder involvement in China, it reveals different forms of stakeholder participation at the provincial, subdistrict and community levels, with participation levels increasing as geographic scale decreases. Noting that the general public is primarily situated at the information end of Arnstein's (1969) ladder, it highlights the emerging role of brokers, including chief urban designers and community planners, in maintaining dialogue between the general public and government authorities. While traditional visualisation media, such as text and 2D plans, are still widely used for planning communication in the statutory planning process, more advanced and interactive tools are emerging at different stages. In the present research contexts, visualisation media were found to effectively aid planning communication, stakeholder awareness, cultural rehabilitation, and political attitudes. Their usage is dependent on the budget available and the intended effects; however, one general recommendation is for wider use of visualisation media to enhance participation levels. Within all the case studies, there are only marginal differences in perceptions of planning information between different categories of stakeholders. This suggests a need for more inclusive participation in the planning process. Since size and type of visualisation media play a role in stakeholder perceptions, using a combination of analogue and digital devices

is recommended in order to respond to diverse stakeholder needs. Finally, future research is needed to examine the research questions in different cultural, social and political contexts and to minimalise the ethical bias of presenting and preparing visualisation media.

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Appendices

Number	Name
A	Copyright permissions
B	Laws and regulations regarding stakeholder participation in urban planning across planning levels
C	Questionnaire for the UPEH study
D	Evaluation criteria for the breadth of knowledge
E	Criteria for measuring the depth of knowledge
F	Marking process for measuring the depth of knowledge
G	Information sheet for the pop-up university activity
H	Consent form for the pop-up university activity
I	Questionnaire for the pop-up university activity
J	Questionnaire for the Puntoon Wuyue renewal project
K	Document analysis for the Pazhou Internet Innovation Cluster project
L	Photo of exhibits in the Guangzhou UPEH
M	Photo of visualisation media in the Pazhou project
N	Photo of visualisation media at different planning stages of the Pontoon Wuyue case study

Appendix A - Copyright permissions

Below is a summary of permissions obtained for using publications in part or in whole in my thesis.

Number	Year	Type	Co-author	Journal/Publisher
1	2020	Journal	Hehl-Lange, S., & Lange, E.	Wichmann Verlag
2	2021	Journal	Tomkins, A., Hehl-Lange, S., & Lange, E.	Elsevier
3	2021	Journal	Lange, E.	Landscape Architecture Journal
4	2021	Journal	Hehl-Lange, S., & Lange, E.	Wichmann Verlag

Permission from publishers

Publication 1 &4
The papers are published in the JoDLA by Wichmann Verlag, which is an open-access journal.

Paraphrase of original articles have been conducted.

Publication 2
Computers, Environment and Urban systems is published by Elsevier. The website page on permissions states that partial or full use of the journal article in PhD thesis is allowed:

> Can I use material from my Elsevier journal article within my thesis/dissertation? –
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> As an Elsevier journal author, you have the right to Include the article in a thesis or dissertation (provided that this is not to be published commercially) whether in full or in part, subject to proper acknowledgment; see the Copyright page for more information. No written permission from Elsevier is necessary.
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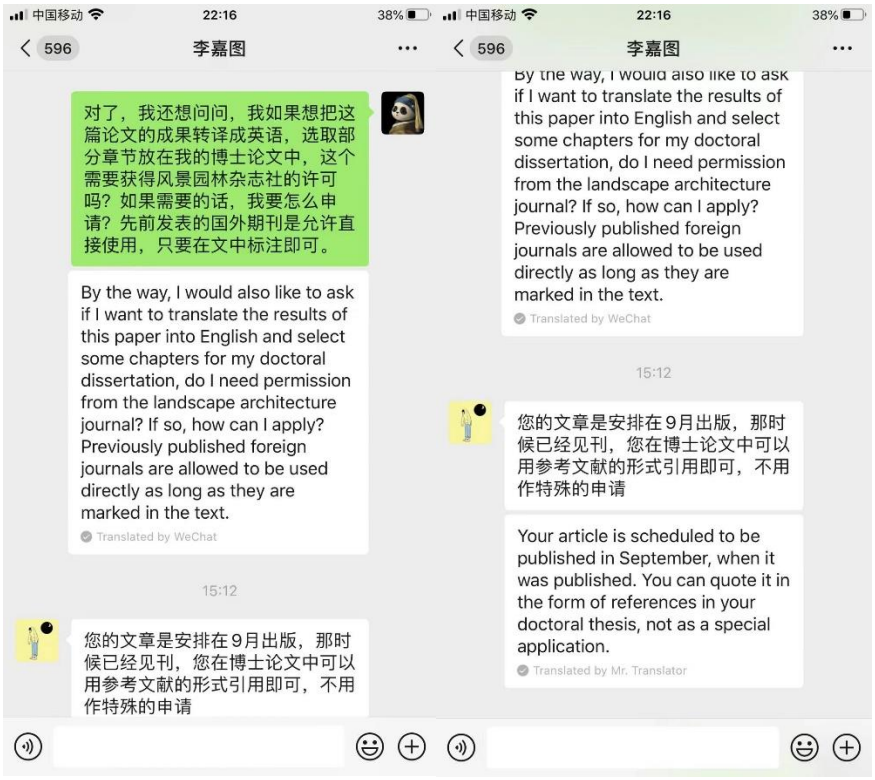
> This right extends to the posting of your thesis to your university's repository provided that if you include the published journal article, it is embedded in your thesis and not separately downloadable.

See: https://www.elsevier.com/about/policies/copyright/permissions
(Accessed 10 August 2021)

Publication 3

The published file was written in Chinese. The Journal has allowed the author to "translate relevant materials into English, and include it in part or full within the thesis, and make proper acknowledgements where appropriate" See the translated WeChat dialogues with corresponding Editor Qingqing Li.



Appendix B - Laws and regulations regarding stakeholder participation in urban planning across planning levels

Level	Explanation	Code	Examples	Time	Formulation body
National	Law	N1	Urban and Rural Planning Law of China	2008	State Council of China
	By-laws	N2	Measure for urban planning publicity and information	2013	Ministry of Housing and Urban-Rural Construction of the People's Republic of China (MHURC)
		N3	Measure for formulation and approval of provincial urban planning system	2010	MHURC
Provincial	Administrative regulations	P1	Ordinance of Urban and Rural Planning in Guangdong	2013	Standing Committee of People's Congress (SCPC) of Guangdong
		P2	Regulation on the Implementation of the Coordinated Development of the Pearl River Delta Urban Agglomeration in Guangdong Province	2014	SCPC of Guangdong
	Administrative rules	P3	Guideline for Publicity and Disclosure of Detailed Regulatory Planning in Guangdong Province	2012	Housing and Urban Rural Development Department (HURDD) of Guangdong
		P4	Guideline for Formulation of Detailed Regulatory Planning in Guangdong Province	2005	HURDD of Guangdong
City	Local regulations	FS1	Urban and Rural Planning Regulation of Foshan	2018	SCPC of Foshan
		GZ1	Urban and Rural Planning Regulation of Guangzhou	2015	SCPC of Guangzhou
		SZ1	Urban and Rural Planning Regulation of Shenzhen	2019	SCPC of Shenzhen
		ZH1	Urban and Rural Planning Regulation of Zhuhai	2013	SCPC of Zhuhai

Appendix B continued

Level	Explanation	Code	Examples	Time	Formulation body
City	Local regulations	ZQ1	Management Regulation on Publicity of Urban and Rural Planning in Zhaoqing	2017	SCPC of Zhaoqing
		ZS1	Management Regulation on Urban Planning in Zhongshan		SCPC of Zhongshan
	Local governmental rules	DG1	Urban and Rural Planning Regulation of Dongguan	2017	HURDB of Dongguan
		GZ2	Measure for publicity of urban and rural planning in Guangzhou	2014	HURDB of Guangzhou
		FS2	Measure for the Administration of Publicity of Urban and Rural Planning in Foshan	2015	HURDB of Foshan
		HZ1	Standard for Urban and Rural Planning Administration of Huizhou	2016	HURDB of Huizhou
		HZ2	Measure for Implementing Publicity in Urban and Rural Planning of the Huizhou City	2020	Natural Resources Bureau (NRB） of Huizhou
		JM1	Management Regulation on Urban and Rural Planning of the Zhongshan City	2013	NRB of Jiangmen
		JM2	Measure for Implementing Publicity in Urban and Rural Planning of the Jiangmen City	2019	NRB of Jiangmen
		ZH2	Measure for the Administration of Publicity of Urban and Rural Planning in Zhuhai	2016	Housing and Urban Rural Development Bureau of Zhuhai (HURDB of Zhuhai)

Appendix C - Questionnaire for the UPEH study

Before visiting-Demographic info

Participant Number _____Age _____Occupation_____ Gender_____

Birthplace_____ Time stay in Guangzhou_____Education Level_____

Coming alone or not (with children or not) _____Follow a guide or not _____

1. Why do you come to visit this exhibition hall?
   A. For gaining new experience
   B. For accompanying friends/families
   C. For learning knowledge about planning and design
   D. For hobby
   E. For leisure

2. What do you expect to get from Guangzhou Urban Planning Exhibition Hall?
   A. Historical evolution of Guangzhou
   B. The current situation of planning and design
   C. The future plan of Guangzhou
   D. Other story about municipal facilities
   E. Other_____

3. Everybody knows a little bit about urban planning and design.On a scale of 1 to 5 (1 you know absolutely nothing about planning and design and 5 you're an expert in it), how would you rate your knowledge about landscape and urban planning in Guangzhou?
   A. 1
   B. 2
   C. 3
   D. 4
   E. 5

4. On a scale of 1 to 5 (1 you are not familiar and 5 you're experienced in it), how would you rate your experience about public participation in Guangzhou? (i.e., participate in governmental publicity, symposium, hearings, put forward suggestions towards planning and design)
   A. 1
   B. 2
   C. 3
   D. 4
   E. 5

Before visiting-Test questions of planning and design in Guangzhou

1. Guangzhou has a city landscape which is characterized as '( ) veins leading to the sea and green mountains half included in the city.'
   A. Four B. Six C. Eight D. Ten E. I don't know.
2. Which of the following cities is the birthplace of the Maritime Silk Road?
   A. Shenzhen B. Guangzhou C. Dongguan D. Zhaoqing E. I don't know.
3. In 1918, Sun Yat-sen published the "Strategy for the Founding of the People", proposing to build Guangzhou into a southern port and establish a ()
   A. International City B. Garden City C. Strategic Fortress
   D. Political Center E. I don't know.
4. In the middle of the Qing Dynasty, the dynamic long scrolls of Guangzhou Port and Guangzhou Fucheng show the scenes of the "Thirteen Hongs of canton" traders for conducting foreign trade before the Opium War. The most popular goods sold that time include tea, silk, export painting, and ().
   A. Kwon-glazed porcelain B. Yue-glazed porcelain C. Wood carving
   D. Calligraphy E. I don't know
5. () is the largest Chinese Gothic stone church. It is built with granite, commonly known as the stone room.
   A. Sacred Heart Cathedral B. Light Tower C. Huaisheng Temple
   D. Christ Church E. I don't know.
6. Which of the following buildings does **not** belong to the native style of Lingnan ().
   A. Dan Bark House B. Yu Yin Garden C. Haizhu Temple D. Zhutong House
   E. I don't know.
7. Which of the following city landmarks is **not** on the new axis of the Guangzhou City?
   A. Guangzhou Tower B. Haixinsha Island C. Guangzhou Railway Station
   D. Tianhe Sports Center E. I don't know.
8. In the future, Guangzhou will realize the spatial strategic planning of "one river, two banks, and three beltss". Which of the following areas does **not** belong to the Golden Triangle?
   A. Pearl River New City B. International Finance City C. Pazhou Internet Cluster
   D. Baiyun New City E. I don't know.
9. According to the 2015 Guangzhou Rail Line Network Plan, there will be () Metro lines in Guangzhou in the future with a total mileage of 1025 kilometers.
   A.15 B. 18 C. 20 D.23 E. I don't know.

10. Do you know anything about landscape and urban planning in Guangzhou over a period that include past, present and future?
    (e.g., urban morphology, economic structure, landscape pattern, historical and cultural heritage, city protection, integrated transportation, municipal facilities, ecological environment, etc.)

After visiting

Participant Number_____

1. Everybody knows a little bit about urban planning and design. On a scale of 1 to 5 (1 you know absolutely nothing about planning and design and 5 you are an expert in it), how would you rate your knowledge about landscape and urban planning in Guangzhou？

A. 1
B. 2
C. 3
D. 4
E. 5

2. On a scale of 1 to 5 (1 you are not familiar and 5 you are experienced in it), how would you rate your experience about public participation in Guangzhou？ (i.e., participate in governmental publicity, symposium, hearings, put forward suggestions towards planning and design）

A. 1
B. 2
C. 3
D. 4
E. 5

3. Short answer question

   Which exhibits do you like the most during the visit? Why? Which exhibits that you dislike the most during the visit? Why?

4. What kind of content/visualisation media in the urban planning exhibition hall interests you most?

5. Have you gained a new learning experience after this visit? If so, what have you learned?

6. Do you have any suggestions for the Guangzhou urban planning exhibition hall?

Appendix D - Evaluation criteria for the breadth of knowledge

No.	Category	Description	Example answers from participants
1	Historical layout	The historical evolution and urban form of the area	The evolution of Guangzhou City. In the Qin Dynasty, it was called Panyu; and after successive dynasties, several cities were established. Later on, the three cities were merged into one city. The Liumaiqu was established. After the Qing Dynasty, the local government lifted the ban on maritime trade and set up a custom office. (A18, after visiting)
2	Future planning	Future of city planning, such as zoning, key development areas.	As we can see from the sand table model, it (the Guangzhou city) developed along the Pearl River. The future planning of Guangzhou takes into account the geographical characteristics of the city and the current planning. The current development trend is the Internet, therefore, an Internet Innovation Cluster will be built along with the financial centres in Guangzhou (A55 After) .
3	Economy and Geography	production, distribution and trade, as well as consumption of goods and services	Guangzhou has been a business capital for 2000 years. Most traditional manufacturing industries have been transferred. The industrial layout is related to the economic strategy. Following the trend in economic development, some of the newly emerging industries are being developed in Guangzhou. In terms of position, it will have some influence on cities such as Shenzhen. But in fact, Guangzhou still preserves many traditional industrial advantages. For example, it can be developed as a free trade zone because it has a port. (A12 before)
4	Landscape and environment	The varied interactions between people and the landscapes and environments	In terms of the ecological environment, there is a Baiyun Lake in Baiyun district. The Haizhu Lake Wetland Park is located in Haizhu District. These are very popular (A13 before).
5	Culture heritage	the legacy of tangible and intangible heritage assets of Guangzhou from past times	Historical and cultural heritage-Guangzhou's Nanyue King Tomb, Guangxiao Temple, Chen Clan Ancestral Hall, and Xiguan Mansion. There are also legends about Dongshan Master, the arcade, the Haizhu Bridge which used to be bombed by Japanese in the 1930s. All these are bits of Guangzhou.

Appendix D continued			
6	Preservation of ancient buildings/districts	The convention of historical area	The convention of historical area: Lychee Bay, Enning Road which is charatered with historical arcade. Then there are several (historical) spots near the red brick field. (A4 before)
7	Transportation	the movement of goods and persons from place to place and the various ways by which such movement is accomplished.	For traffic, from the perspective of development, I can't say too much. I feel that the subway in Guangzhou is very good, and it is really importatnt for alleviating the traffic congestion in Guangzhou (A14)
8	Municipal utility	Provide public service to the city, including electricity, power etc.	Now there should be some integrated pipe corridors. Examples include some on-going renovations in the Guangzhou University. It also meets the current water environment treatment of municipal facilities. (A4)

Appendix E - Criteria for measuring the depth of knowledge

Scale	Category	Description	Examples about knowledge of transportation
0	Not at all	Can say nothing	I feel that I know nothing about this area (A3)
1	Extremely limited	roughly or inaccurately summarized.	Traffic (in Guangzhou) is very convenient now (A7 before)
2	Somewhat limited	correct but are superficially described.	The traffic in the urban area is relatively developed. However, the more you go to the surrounding places such as Baiyun and Zengcheng District, the situation will be much worse (A6 after)
3	Generally Adequate	competently described.	In terms of traffic, the main impression is that the subway line network has only 7-8 lines in Guangzhou now. There will be 23 lines in the future, connecting all the areas of Guangzhou with its surrounding cities. (A23)
4	Fairly Good	Evidence of close understanding	Apart from the two major comprehensive transportations mentioned earlier, namely the international shipping industry and international aviation, there are also the railway, urban rail transit, and subway (A4 after)
5	Excellent	Well explained, with detailed information	I think I may understand better about the mode of transportation. When I was young, I was very impressed by the construction of the subway lines. It was probably in the early 2000s, only Line 1 and Line 2 were being built then. It has a narrow scope and it is only reachable to the old city. At that time, my family lives in the Tianhe district; we did not have a car at the time. when I go out, I feel very inconvenient to take a bus or walk. Then, Line 3 was built in 2006-2007, and I felt that the accessibility to the entire city had improved a lot. When I was in the junior high school, the BRT program was reconstructed quickly. The path of BRT was specified on the ground, which speed up the transportation pace. With the BRT I will never be stuck on the road like other cars. Through my usual daily life, I feel that the traffic in Guangzhou is getting much more convenient than before (A30 before)

Appendix F - Marking process for measuring the depth of knowledge

Colour scheme for different topics

No.	Category	Colour
1	Urban development and layout (history)	
2	Future planning	
3	Economy and Geography	
4	Landscape and environment	
5	History and culture	
6`	Historical preservation of ancient buildings/districts	
7	Transportation	
8	Utility	

Scoring for participant A13 before and after visiting
Participant A13: Knowledge before visiting

A13: Not very familiar, but what should I say? The main axis of the city is definitely in Tianhe CBD. The key development area must be the CBD in the Tianhe District. Then the future development direction should be near the area of the Baiyun New City. I am not very sure about the economic structure. For historical and cultural heritage, the Nanyue King Museum is one of such examples. I don't know about the protection of historical cities. In terms of the traffic, basically the old urban area and some new districts are known to most people who have been there. As for the ecological environment, there is a Baiyun Lake in the Baiyun new city, and a Haizhu Lake Wetland Park in the Haizhu district. These are much popular mow.

Participant A13: knowledge gaing after visiting

I have a more detailed understanding of the urban form, for which I know a long-term perspective of the urban revolution. I also know a bit more about economic structure. Historically,

Guangzhou's is the origin of Silk Road and the 13 hungs. The other aspects of it are urban planning and urban ecology. As we have seen the "after 2050", I can say that I have more profound understanding of the future development of Guangzhou as well as all different aspects of urban layout. In terms of the traffic, the main impression is that the subway line network has only 7-8 lines in Guangzhou now, and there will be 23 lines in the future, which will connect all the areas of Guangzhou with the surrounding cities.

Score of A13 before and after visiting

		Breadth		Depth	
No.	Category	Before	change	Before	change
1	Urban development and layout (history)	1	+0	2	+1
2	Future planning	1	+0	1	+2
3	Economy and Geography		+1		+1
4	Landscape and environment	1		2	
5	Cultural heritage	1	+0	1	+1
6`	Historical preservation of cites				
7	Transportation		+1		+3
8	Municipal Utility				

Appendix G - Information sheet for the pop-up university activity

Participant Information Sheet

Explore the Pazhou Internet Innovation Cluster, Guangzhou, China

Aims of the research project

You are being invited to participate in the Adaptive Urban Transformation (AUT) research project, which is funded by the Newton Fund / Engineering and Physical Sciences Research Council (EPSRC) as part of the Sustainable Deltas award.

This study is focused on the future appearance of the Pazhou Internet Cluster Area in Guangzhou, China. It aims to understand people's perception of the urban environment through Virtual Reality (VR) devices. We are inviting a range of foreign and domestic participants to take part in our study. The immersive walkthrough will take approximately 5-10 minutes. After that, we will ask you some short questions regarding your experience.

Potential risks of wearing VR headsets

The VR experience is very similar to the computer game environment. Therefore, there is a small likelihood of physical or psychological harm/distress. Occasionally, participants could experience slight nausea, anxiety and eye strain. If you are pregnant, elderly, or having pre-existing conditions (i.e., vision abnormalities, psychiatric disorders, heart conditions), we suggest you do not take part in the experiment. You are free to withdraw from the session at any time. Please inform the researchers if you are not feeling well.

What will we do with the information?

Each participant will be given a reference number to ensure anonymous participation. We will track your viewing direction in the digital models. We will also record what you say in the follow-up interview, either in writing, or through an audio tape. During the experiment, we will store your information in a password protected laptop. Afterwards, it will be stored on an encrypted hard disk of the research team. Physical copies of questionnaires will be kept in a locker at the lab and locked with a key.

All the information that we collect about you will be kept strictly confidential and will only be accessible to members of the research team. You will not be able to be identified in any reports or publications unless you have given your explicit consent for this. If you agree to us sharing the information you provide with other researchers then your personal details will not be included unless you explicitly request this. The data you provide will be kept in an anonymised way, and it will be destroyed three years after publication. The University of Sheffield will act as the Data Controller for this study. This means that the University is responsible for looking after your information and using it properly.

Your participation in this project is greatly appreciated. You are free to withdraw at any time.

Thank you very much for reading!

This project has been ethically approved via the University of Sheffield's Ethics Review Procedure, as administered by the department of Landscape Architecture. If you have any queries, please feel free to contact the research team or the university.

Contacts:

Prof. Dr. Eckart Lange	e.lange@sheffield.ac.uk	Dr. Sigrid Hehl-Lange	s.hehl-lange@sheffield.ac.uk
Dr. Adam Tomkins	a.tomkins@sheffield.ac.uk	Ms. Xi Lu	xlu21@sheffield.ac.uk

According to data protection legislation, we are required to inform you that the legal basis we are applying in order to process your personal data is that 'processing is necessary for the performance of a task carried out in the public interest' (Article 6(1)(e)). Further information can be found in the University's Privacy Notice: https://www.sheffield.ac.uk/govern/data-protection/privacy/general

Appendix H - Consent form for the pop-up university activity

Consent Form

Explore the Pazhou Internet Innovation Cluster, Guangzhou, China

Please tick the appropriate boxes	Yes	No
Taking Part in the Project		
I have read and understood the project information sheet.	☐	☐
I have been given the opportunity to ask questions about the project.	☐	☐
I understand that taking part in the project will include: • looking at digital models • tracking the viewing direction in the digital models • completing a questionnaire	☐	☐
I understand that my taking part is voluntary and that I can withdraw from the study at any time; I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw.	☐	☐
How my information will be used during and after the project		
I understand my personal details such as name, postcode and email address etc. will not be revealed to people outside the project.	☐	☐
I understand and agree that my words may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this.	☐	☐
I understand and agree that other authorised researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form.	☐	☐
I understand and agree that other authorised researchers in the research team may use it in publication analysis, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.	☐	☐
I give permission for the experiment data that I provide to be stored on an encrypted hard disk of the research team so it can be used for future research and learning	☐	☐

Name of participant **Signature** **Date**

Name of Researcher **Signature** **Date**
Xi Lu 陆熹 Xi Lu

Project contact details for further information:

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Appendix I - Questionnaire for the Pop-up university activity

Phase 2015

EXPLORE THE PAZHOU INTERNET INNOVTION CLUSTER, GUANGZHOU, CHINA

Date .....am/pm Participant Number .....

PLEASE FILL IN THE FOLLOWING INFORMATION (Tick ✓ one box only)

Gender: ☐ Female ☐ Male ☐ Other

How would you describe your ethnic origin?
☐ White ☐ Mixed/Multiple ethnic groups ☐ Asian/Asian British ☐ Arab
☐ Chinese ☐ Black/African/Caribbean/ Black British ☐ Other ethnic group

How old are you?
☐ Under 18 ☐ 18 – 24 ☐ 25 – 34 ☐ 35 – 44 ☐ 45 – 54 ☐ 55 – 64 ☐ 65+

What is the highest level of education you have completed?
If you have qualifications gained outside the UK, tick the nearest UK equivalents (if known)
☐ Primary school ☐ GCSE or equivalent ☐ A Level or equivalent
☐ University degree (BA, BSc) ☐ Higher degree (MA, PhD, PGCE) ☐ Other qualifications

Your profession: ..... Student: ☐ Yes ☐ No

Have you got a background in one or more than one of the following disciplines? You can tick more than one.
☐ Architecture ☐ Urban planning ☐ Landscape architecture ☐ Other related disciplines, which: .....

Do you have previous experience with VR? ☐ Yes ☐ No

PLEASE ANSWER THE FOLLOWING QUESTIONS BASED ON YOUR VR EXPLORATION

1. **Where** do you think you have looked at the most? Why?

2. How **tall** is the highest building in the model that you have seen? Please give an estimate (in meter) .....

3. How **many** buildings did you see? .....

4. How **far** do you think you have travelled in the model (in meter)? .....

5. Please **describe** your VR experience of Pazhou Internet Cluster on the following scale.

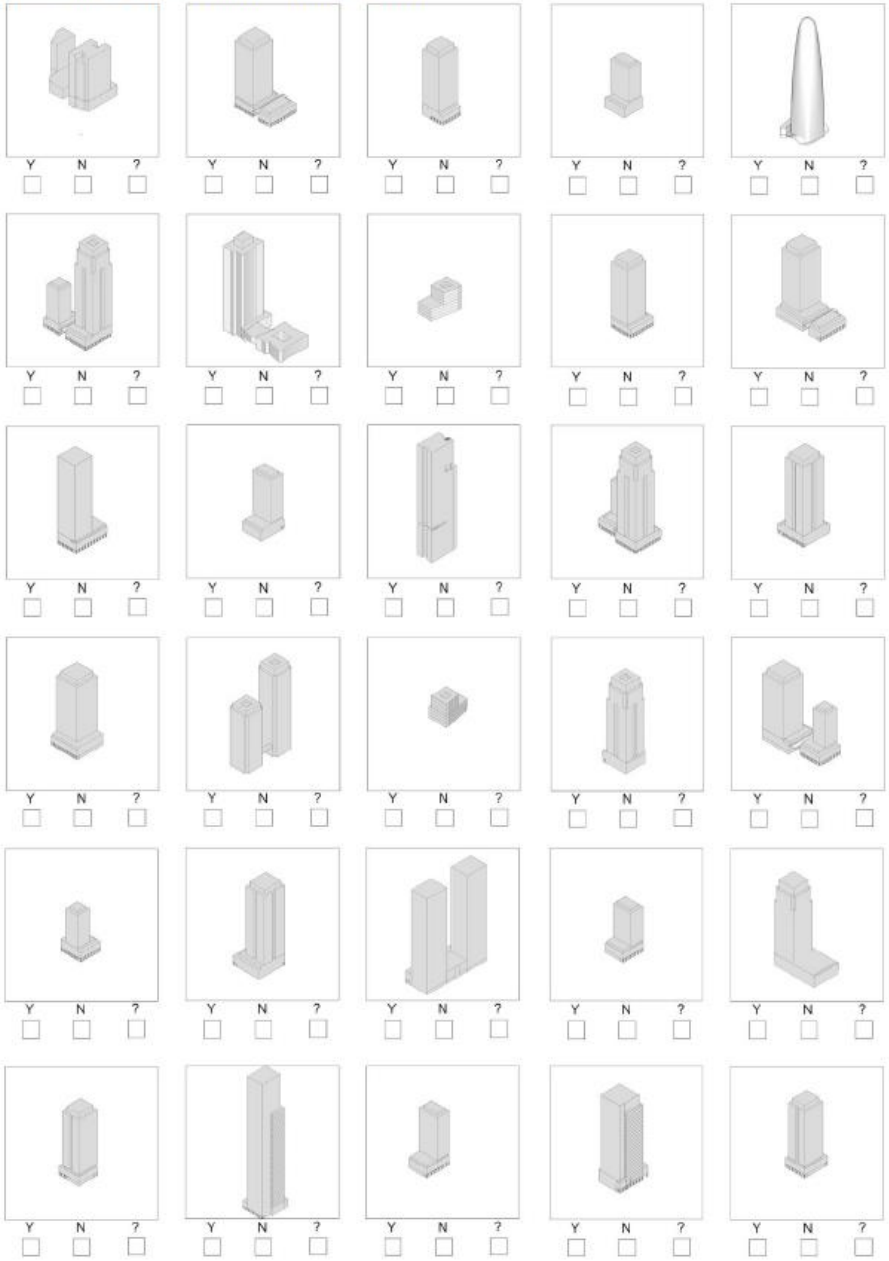
		2	1	0	1	2	
VR experience	Helpful for understanding	☐	☐	☐	☐	☐	Not helpful for understanding
	Easy to use	☐	☐	☐	☐	☐	Hard to use
	Realistic	☐	☐	☐	☐	☐	Abstract
Urban design	Detailed	☐	☐	☐	☐	☐	Simple
	Interesting	☐	☐	☐	☐	☐	Boring
	Beautiful	☐	☐	☐	☐	☐	Ugly
	Unique	☐	☐	☐	☐	☐	Repetitive

Please turn over to finish the scorecard

SCORECARD

FOR EACH PICTURE, PLEASE TELL US IF IT WAS IN THE MODEL OR NOT

Please tick Y (yes) / N (no) / ? (I don't know)



Thank you very much for your participation!

EXPLORE THE PAZHOU INTERNET INNOVTION CLUSTER, GUANGZHOU, CHINA

Date .....am/pm Participant Number .....

PLEASE FILL IN THE FOLLOWING INFORMATION (Tick ✓ one box only)

Gender: ☐ Female ☐ Male ☐ Other

How would you describe your ethnic origin?
☐ White ☐ Mixed/Multiple ethnic groups ☐ Asian/Asian British ☐ Arab
☐ Chinese ☐ Black/African/Caribbean/ Black British ☐ Other ethnic group

How old are you?
☐ Under 18 ☐ 18 – 24 ☐ 25 – 34 ☐ 35 – 44 ☐ 45 – 54 ☐ 55 – 64 ☐ 65+

What is the highest level of education you have completed?
If you have qualifications gained outside the UK, tick the nearest UK equivalents (if known)
☐ Primary school ☐ GCSE or equivalent ☐ A Level or equivalent
☐ University degree (BA, BSc) ☐ Higher degree (MA, PhD, PGCE) ☐ Other qualifications

Your profession: ..... Student: ☐ Yes ☐ No

Have you got a background in one or more than one of the following disciplines? You can tick more than one.
☐ Architecture ☐ Urban planning ☐ Landscape architecture ☐ Other related disciplines, which: .....

Do you have previous experience with VR? ☐ Yes ☐ No

PLEASE ANSWER THE FOLLOWING QUESTIONS BASED ON YOUR VR EXPLORATION

1. **Where** do you think you have looked at the most? Why?

2. How **tall** is the highest building in the model that you have seen? Please give an estimate (in meter) .....

3. How **many** buildings did you see? .....

4. How **far** do you think you have travelled in the model (in meter)? .....

5. Please **describe** your VR experience of Pazhou Internet Cluster on the following scale.

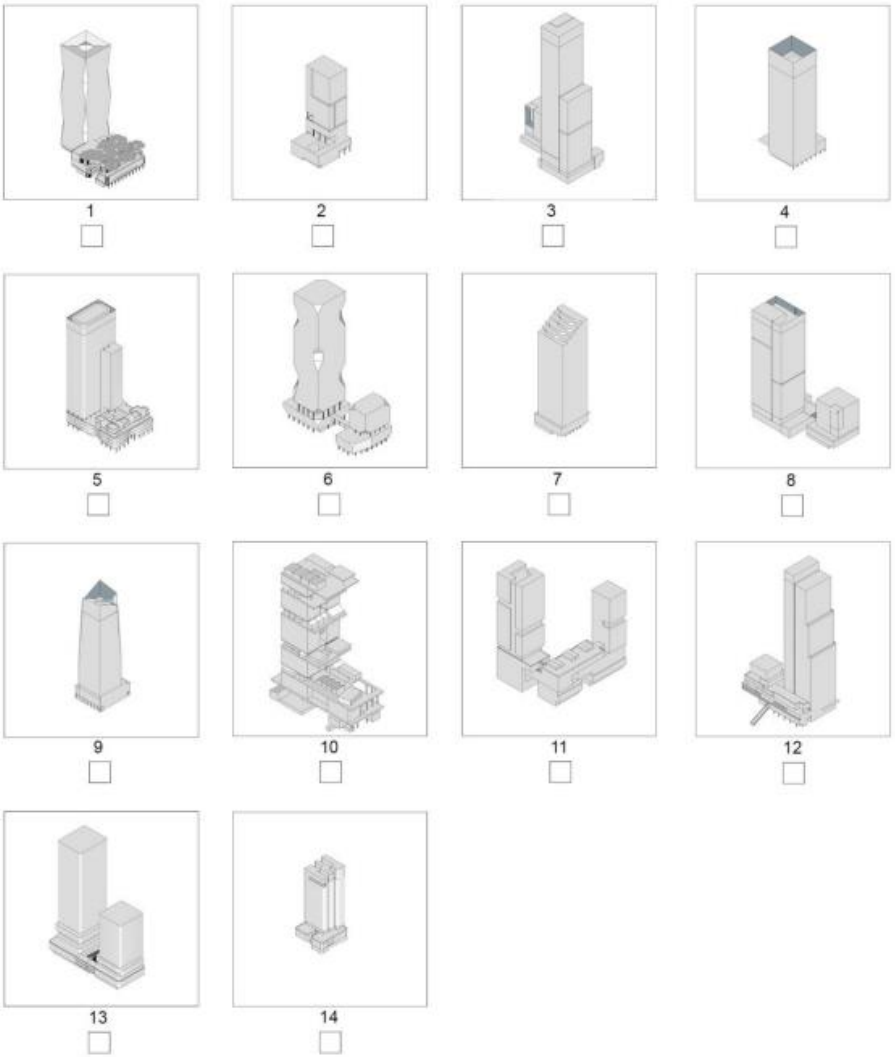
		2	1	0	1	2	
VR experience	Helpful for understanding	☐	☐	☐	☐	☐	Not helpful for understanding
	Easy to use	☐	☐	☐	☐	☐	Hard to use
	Realistic	☐	☐	☐	☐	☐	Abstract
Urban design	Detailed	☐	☐	☐	☐	☐	Simple
	Interesting	☐	☐	☐	☐	☐	Boring
	Beautiful	☐	☐	☐	☐	☐	Ugly
	Unique	☐	☐	☐	☐	☐	Repetitive

Please turn over to finish the scorecard

SCORECARD

Date .....am/pm Participant Number .....

WHICH ONE OF THESE BUILDINGS DO YOU LIKE BEST?
Please tick your **Top 3**



Thank you very much for your participation!

If you would like to receive updates of our research progress, please write down your e-mail address.

Email: .....

Appendix J - Questionnaire for the Puntoon Wuyue renewal project

Dear Sir/Madam,

I am a PhD researcher from the University of Sheffield, UK. I would like to invite you to participate in my research, which seeks to examine the interaction of stakeholders and their perceptions of visualisations tools throughout different development phases of the project. The questionnaire is **targeted at adult participants who have partially/fully engaged in the inventory and enquiry, planning and design, evaluation, decision-making, implementation and maintenance phases** in relation to the renewal of the **Sanguan Temple Square**. I would welcome your feedback, if you are a v**illager, tenant, community planner, designer, news media, government official, expert etc**. Your response will be kept strictly confidential and will only be used for research purposes. This survey will take about ten minutes. Thank you so much for your assistance.

Part I

Your Demographic Info

1. Your Gender
A. Male
B. Female

2. Your Age Group：
A. Below 18 (for ethic reasons, questionnaire ends)
B. 18-30
C. 31-45
D. 46-60
E. 61 and above

3. Your Education Level
A. Junior school and below
B. High school
C. University and college
D. Master and above

Part II

The stakeholder group you belong to and your interaction with others

4. Please select the stakeholder group you belong to concerning the Puntoon Wuyue mircro-renewal project
A. Local residents （including those moved to resettlement housing）

B. Residential or commercial tenants in the village
C. Community planners
D. News media
E. Designers from Urban Elephant Architecture Co. ltd
F. Cross-strait Workshop participants
G. Gate Competition participants
H. Government officials at the local level (*Jiedao*)
I. Government officials at the district level
J. Government officials at the city level
K. Academic consultants
L. Construction team
M. Other citizens/tourists

5. What is your main **influence** on the mircro-renewal project?
A. Knowledge
B. Assets
C. Social skills
D. Hierarchical position

6. How do you think of your **influence degree** on the mircro-renewal project?
E. Very High
F. High
G. Normal
H. Low
I. None/Minimum

7. What is your main **interest** in the micro-renewal project?
A. Community benefits
B. Economic interest
C. Roles and responsibilities
D. Self-fulfilment

8. How do you think of your **interest** level in the renewal project?
A. Very High
B. High
C. Normal
D. Low
E. No or minimum

9. During the mircro-renewal process, have you ever engaged in the following **phases** of the micro-renewal project? [Multiple]

A. Invention and Enquiry
(examining the local needs and culture through symposiums, focus groups, explanation meetings, personal communication)

B. Planning and design
(discussion regarding the square renewal and gate reinstallation through workshops, including 'I am living in Wuyue' exhibition, evaluation for cross-strait workshop, 1:1 model construction, competitions, focus groups, personal communication etc.)

C. Decision-making
(voting for gate design competition, or other focus groups for evaluation purposes, approval of the plan and design, such as expert meeting)

D. Implementation and Maintenance
(construction of the proposed design)

E. None of them

（if 7-ABCD is selected）

10. how was your **engagement degree** in the micro-renewal project?
A. I can make decisions over the project by myself）
B. I cooperate with other stakeholders towards a final decision
C. My suggestions are collected and my inputs are taken into account in the decision making
D. I have been asked for feedback regarding the project
E. I am only informed about the project
F. I didn't participate at all.

（if 7-E is selected）

11. Why don't you participate in the aforementioned phases?
A. Time conflict
B. I think it is merely formalism
C. My suggestions will not be adopted
D. It is none of my business
E. Others, please specify_____
[the questionnaire ends for those selecting 7-F none-participation in the project]

12. Concerning the renewal project, have you ever communicated with **the following stakeholder groups** (including the group you belong to)? [multiple]
A. Local residents (including those moved to resettlement housing)
B. Residential or Commercial tenants in the village
C. Community planners
D. News media

E. Designers from Urban Elephant Architecture Co. ltd
F. Cross-strait Workshop participants
G. Gate Competition participants
H. Government officials at the local level (*Jiedao*)
I. Government officials at the district level
J. Government officials at the city level
K. Academic consultants (Experts)
L. Construction team
M. Other citizens/tourists

Options selected from Q12 are presented in Q13

13. **How often** do you communicate with them? Please select the most appropriate one

	1-2 times per year	1-2 times per semester	1-2 times per month	1-2 times per week
(12-A) Local residents	○	○	○	○
(12-B) Tenants	○	○	○	○
(12-C) Urban planners	○	○	○	○
……	○	○	○	○
12-M Other citizens/tourists	○	○	○	○

Options selected from Q12 are presented in Q14

14. What is your **relationship** with them? Please select the most appropriate one.

	conflict	Normal	cooperation
(12-A) Local residents	○	○	○
(12-B) Tenants	○	○	○
(12-C) Urban planners	○	○	○
……	○	○	○
12-M Other citizens/tourists	○	○	○

15. In general, are you **satisfied** with the communication effects of the aforementioned stakeholder groups?

A. Very satisfied
B. Satisfied
C. Neutral
D. Dissatisfied
E. Very Dissatisfied

16. Ideally, which of the following **stakeholder groups** would you like to communicate **more often** with (including the group you belong to)? [multiple]

A. Local residents (including those moved to resettlement housing）
B. Residential or Commercial tenants in the village
C. Community planners
D. News media
E. Designers from Urban Elephant Architecture Co. ltd
F. Cross-strait Workshop participants
G. Gate competition participants
H. Government officials at the local level (*Jiedao*)
I. Government officials at the district level
J. Government officials at the city level
K. Academic consultants (Experts)
L. Construction team
M. Other citizens/tourists

Part III

Your perception of communication media

17. During your participation phases, what kind of **visualisation tools** did you use /were presented to you for communication about the project? [multiple]

A. Freehand drawing and sticky notes B. paper map

C. Photograph D. 3D physical model

E. 2D digital map (plan, section etc.) F. 3D modelling and rendering

G. TV/newspaper/Self media H. Others, please specify_____

Options selected from Q17 will show in Q18

18. Is the information conveyed by the media **easy for your comprehension**?

	Hard for comprehension	Normal	Easy for comprehension
15-A freehand sketches and sticky notes	○	○	○
15-B paper map	○	○	○
15-C Photograph	○	○	○
15-D 3D physical model	○	○	○
……			○
15_H others	○	○	○

Options selected from Q17 will show in Q19

19. Is the media helpful for your discussion about the renewal project ?

	Less helpful	Normal	Very helpful
15-A Freehand sketches and sticky notes	○	○	○
15-B paper map	○	○	○
15-C Photograph	○	○	○
15-D 3D physical model	○	○	○
……			
15_H others	○	○	○

If 9–A is selected

20. Ideally, at **inventory** phase of the renewal project, what visualisation tools do you prefer to be employed?
    A. Analogue tools (non-digital tools, such as sketch, paper map, photograph, physical models)
    B. Digital tools (through computerised devices, such as 3D digital rendering, plans, etc.)
    C. A combination of them
    D. No preference

If 9–B is selected

21. Ideally, at **planning and design** phase of the renewal project, what visualisation tools do you prefer to be employed?

A. Analogue tools (non-digital tools, such as sketch, paper map, photograph, physical models)
B. Digital tools (through computerised devices, such as 3D digital rendering, plans, etc.)
C. A combination of them
D. No preference

If 9–C is selected

22. Ideally, at **decision-making** phase of the renewal project, what visualisation tools do you prefer to be employed?
    A. Analogue tools (non-digital tools, such as sketch, paper map, photograph, physical models)
    B. Digital tools (through computerised devices, such as 3D digital rendering, plans, etc.)
    C. A combination of them
    D. No preference

If 9–D is selected

23. Ideally, at **implementation and maintenance** phase of the renewal project, what visualisation tools do you prefer to be employed?
    A. Analogue tools (non-digital tools, such as sketch, paper map, photograph, physical models)
    B. Digital tools (through computerised devices, such as 3D digital rendering, plans, etc.)
    C. A combination of them
    D. No preference

If 20-A, C or 21-A,C or 22-A,C or 23-A, C is selected

24. Which of the following **analogue** tools do you prefer for communication?

A. Sketch
B. Paper map
C. Photograph
D. 3D physical models
E. Others, please specify_____

If 20-B, C or 21-B,C or 22-B,C or 23-B, C is selected

Which of the following **digital** tools do you prefer for communication?

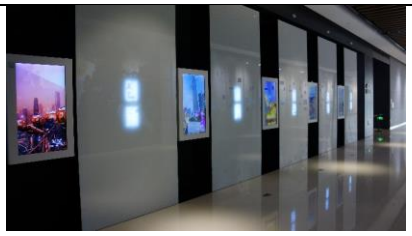
A. electronic sketchboard
B. 2D digital image (plan, section etc)
C. Computer-edited photograph
D. 3D digital rendering
E. Video
F. VR, AR and other advanced digital tools
G. TV news/newspaper/social media
H. Others, please specify_____

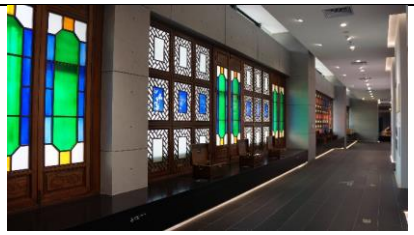
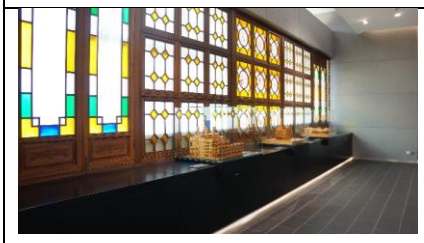
Appendix K - Document analysis for the Pazhou Internet Innovation Cluster

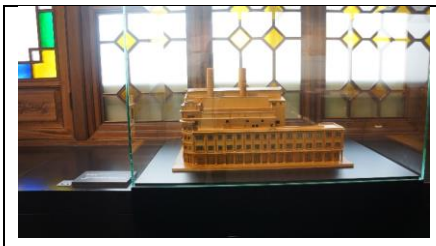
Level	Code	Chinese Name & English name	Time	Authors
Official documents	01	Guangzhou City, Pazhou West (North of Newport East Road) urban design optimization combination and modification of regulatory planning results	2015	Guangzhou Land Development Center
	02	Main drawings of the Pazhou regulatory planning	2014	Guangzhou Urban Planning and Design Institute
	03	Planning for the Guangzhou Zhangzhou Internet Innovation Cluster	2018	Guangzhou Land Resources and Planning Commission
	04	Alibaba South China Operation Center (Plots AH040208 and AH040230 in Pazhou Internet Innovation Area. (http://ghzyj.gz.gov.cn/sofpro/bmyyqt/gzlpc/gfgs/gfgs_content.jsp?pkid=43911)	2016	LRUPB of Guangzhou
	05	Urban and Rural Planning Regulation of Guangzhou. (http://www.gzlpc.gov.cn/zwgk/zcfg/ghzcfg/201708/t20170830_1093365.html)	2015	SCPC of Guangzhou
Meeting notes	01	Notes of the executive meeting of the municipal government (No.282)	2014	Guangzhou municipal government
	02	The Municipal State Planning Commission provides “one-to-one” services for the Pazhou Internet Innovation Cluster Project.	2016	Guangzhou Municipal Planning and Natural Resources Bureau
	03	The decision to implement detailed regulatory planning and optimisation of urban design of Pazhou site A (No. 0011)	2015	Mayor of Guangzhou
Press releases	01	Pazhou Internet Innovation Cluster will be built as CBD Version 2.5	2015	New express
	02	Tencent and Alibaba is coming. Pazhou has approached to the Internet and exhibition era	2015	Nanfang Daily

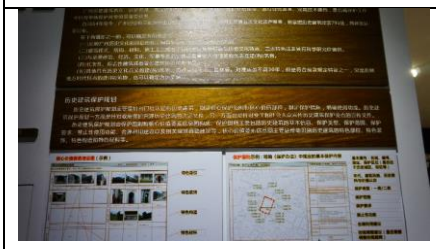
	03	Wechat headquarters building plan has been revealed, let us look at the story behind it	2012	Archcollege Blog
	04	Guideline for Formulation of Detailed Regulatory Planning in Guangdong Province	2005	HURDD of Guangdong
Journal articles	01	The Chief urban designer system for Urban Management in Smart City	2018	Yimin Sun, Sheng Xia and Peijun Lu
	02	A Preliminary Study on the Chief Designer System of Cities in Key Areas	2017	Zhe Cheng

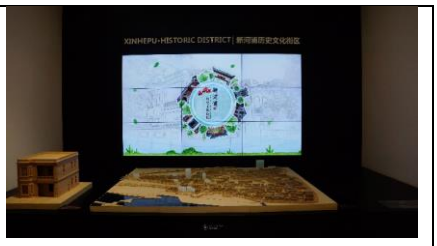
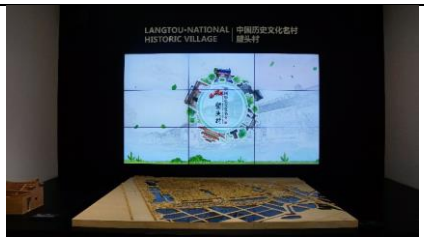
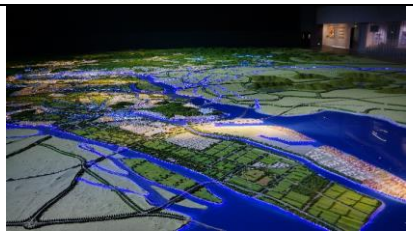
Appendix L - Photo of exhibits in the Guangzhou UPEH

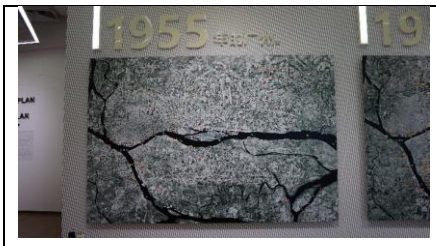
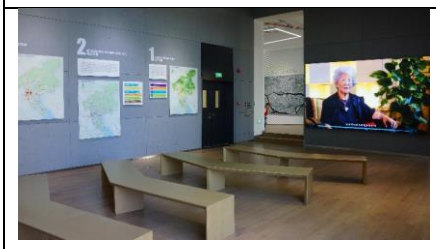
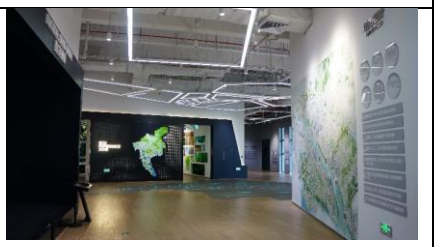
		*Under maintenance*
01 Six-vein map	02 Guangzhou disappears from the horizon	03 Creative center
		
04 Exhibition of He jingtang	05 Publicity of planning	06 Guangzhou and the world
		
07 Three key maps	08 Introduction of Guangzhou	09 Five concepts for development
		
10 4D cinema	11 Shoreline change of the Pearl River	12 Tracing the origin-Preface

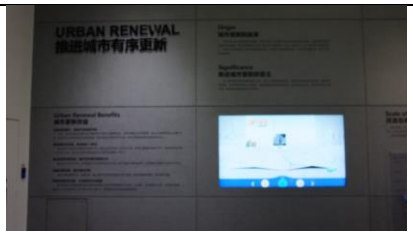
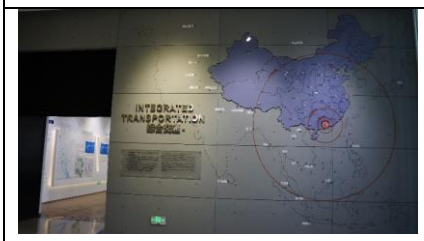
		
13 From Qin to Qing	14 Eaves tile to thirteen hungs	15 Municipal planning in ancient times
		
16 Blessed by the Celestial Officials brick carvings	17 "Waterfront Change" wall hanging - cultural landmark	18 City outline
		
19 Religious architecture in Guangzhou	20 Manchurian window	21 Holographic film and television
		
22 Various physical sculptures	23 Modern city - preface	24 The central axis of the modern city in the 1900s

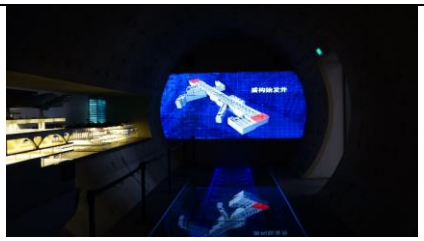
		
25 Wuxianmen power plant - Municipal government office building	26 Partial model of Sun Yat-sen memorial hall	27 Sun Yat-sen memorial hall
		
28 Dashatou Plan - Urban Plan	29 Haizhu Square	30 Arcade light and shadow wall
		
31 Wind coming from all sides-Preface	32 Native culture	33 The north wind spreads towards south
		
34 The westerly winds are gradually moving easterly	35 Lingnan fresh style	36 The east wind is gradually affecting the west

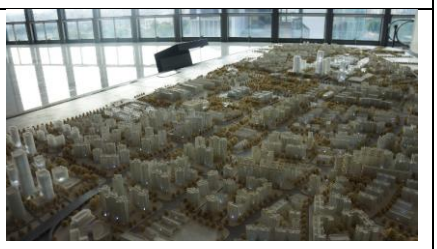
		
37 Sealing cornices	38 Dynamic long rolls	39 Famous city planning - Preface
		
40 Long causeway	41 Sand table of historical city protection	42 Famous city protection system
		
43 Model of Shameen	44 Model of Cheung Chau Island	45 Shawan ancient town
		
46 Historical architecture system	47 Aiqun hotel	48 Models of various gates

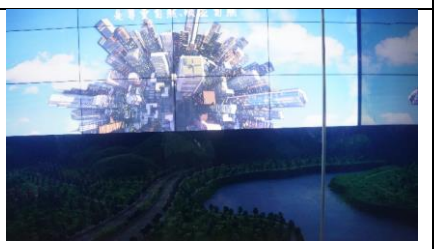
		
49 Signs of historical and cultural blocks	50 Lihuwan Lake-Fengyuan Street	51 Xinhepu historical and Cultural District
		
52 Nanhua west street	53 Langtou village	54 Yangcheng micro film
		
55 Touchable historical and cultural block	56 Street AR	57 City-wide model
		
58 Planning memorabilia	59 Strategic plan and master plan	60 Planning review

		
61 Aerial imagery of 1955	62 Aerial imagery of 1978	63 Aerial imagery of 2017
		
64 Guangzhou city master plan	65 Multiple-regulation combined into one	66 Public services facility
		
67 Detailed regulatory plan	68 Digital sand table	69 Urban design
		
70 Zhujiang New Town	71 The development of detailed regulatory plan	72 Make full use of land resources

		
73 Protect natural ecology	74 Interactive sheepshoe nail ground	75 Surrounding planning
		
76 Rural revitalization	77 Promote urban renewal	78 Open planning
		
79 Hall of Transportation - Preamble	80 Historical memory	81 Development vision
		
82 Air shipping hub	83 Railway hub	84 Intercity rail and road networks

		
85 Sand table model of transportation hub	86 Traffic data platform	87 Street space and chronic traffic
		
88 Guangzhou tram driving experience	89 Public transportation	90 Guangzhou metro-line model
		
91 Transportation planning technology	92 Metro shield	93 Municipal special planning
		
94 The second branch of the first resource thermal power plant	95 Master plan of underground space	96 Municipal and life

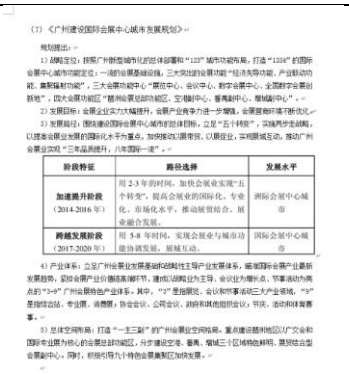
		
97 Invisible pipelines	98 Municipal infrastructure information platform	99 ‘I love Guangzhou’ sculpture
		
100 Three belts on both sides of one river	101 Three major international strategic hubs	102 Airport economic zone
		
103 Guangzhou Higher Education Mega Center	104 Guangzhou knowledge city	105 Nansha suburb center
		
106 Baiyun new town	107 Guangzhou South Railway Station	108 Leap 2050

		
109 International advanced city case study	110 VR overcomes fear of heights	111 VR little planner
		
112 3D printing of medical resource	113 City traffic night race	114 Sponge city
		
115 Smart cities	116 Recycled resources	117 Virtual football game
		
118 Sports games	119 Building toy blocks	

Appendix M - Photo of visualisation media in the Pazhou project

Text

地块位置	海珠区琶洲互联网创新集聚区跨市政道路连接体⑩-2 号地块
土地用途	商务设施用地（B2）兼容商业设施用地（B1）
土地面积（平方米）	317.7
出让年限	商业、旅游、娱乐用地 40 年；综合或者其他用地 50 年
成交价（万元）	820
配建面积（平方米）	0
受让单位	康美健康产业投资有限公司



（7）《广州建设国际会展中心城市发展规划》

规划概述：

1）战略定位：按照广州新型城市化的总体部署和“123”城市功能布局，打造“1024”的国际会展中心城市功能定位：一条的会展基础设施，二大突出的会展功能“经济先导功能，产业联动功能，集聚辐射功能”，三大会展功能平台“展览中心、会议中心、新产业展示中心，全面提升会展创新地”，四大会展功能区“琶洲会展总部功能区、空港新中心、番禺新中心、增城新中心”。

2）发展目标：会展业业实力大幅提升，会展产业竞争力进一步增强，会展营商环境不断优化。

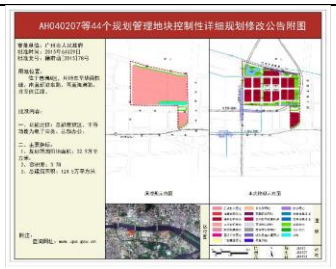
3）发展路径：围绕建设国际会展中心城市的总体目标，立足“五个转变”，实施两步走战略，以提高会展业发展的国际化水平为重点，加快推动八展带动、以展促业，实现展城互动，推动广州会展业实现“三年品质提升，八年国际一流”。

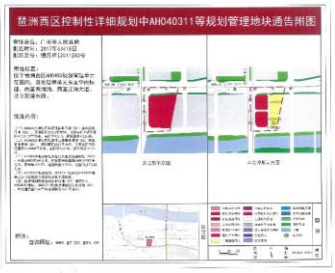
阶段特征	路径选择	发展水平
加速提升阶段（2014-2016 年）	用 2-3 年的时间，加快会展业实现“五个转变”，提高会展业的国际化、专业化、市场化水平，推动展贸结合、展业融合发展。	洲际会展中心城市
跨越发展阶段（2017-2020 年）	用 5-8 年时间，实现会展业与城市功能协调发展，展城互动。	国际会展中心城市

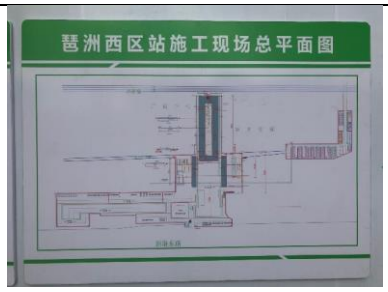
4）产业体系：立足广州会展业发展基础和战略性主导产业发展体系，瞄准国际会展产业最新发展趋势，紧扣会展产业价值链高端环节，建成以战略性产业为主导、会议业为重点、节事活动为亮点的“3+9”广州会展特色产业体系。其中，“3”是指展览、会议和节事活动三大产业领域，“9”是指综合站、专业展、消费展；协会会议、公司会议、政府和其他组织会议；节庆、活动和体育赛事。

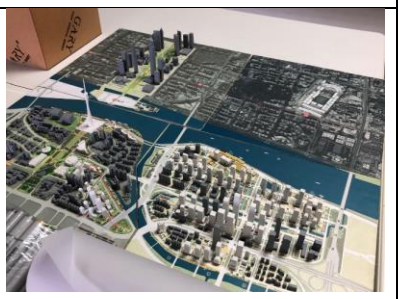
5）总体空间布局：打造“一主三副”的广州会展业空间格局。重点建设琶洲地区以广交会和国际专业展为核心的会展总部功能区，分步建设空港、番禺、增城三个区域特色鲜明、层级结合型会展副中心。同时，积极引导九个特色会展集聚区加快发展。

2D image

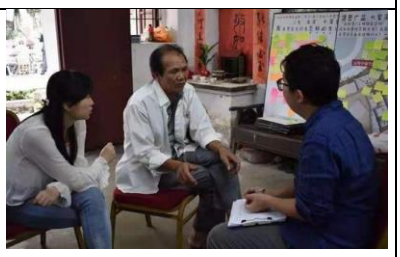


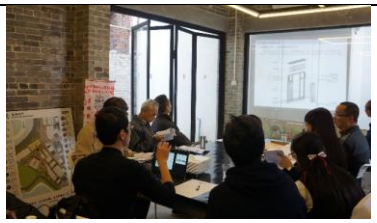




3D physical model		
		
3D visualisation		
		
		
		

Appendix N - Photo of visualisation media at different planning stages of the Pontoon Wuyue case study

Stage 1-Inventory and analysis		
		
Model and sticky notes	Poster and sticky notes	Oral history and note-taking
		
PPT slides	Photo	Paper map
Stage 2-Planning and design		
		
2D plan	3D physical model	3D physical model
		
3D digital model	3D physical model making	Newspaper

Stage 3-Decision-making and evaluation		
		
3D rendering	3D rendering	3D rendering
		
TV broadcast	Text	Oral discussion
Stage 4-Implementation		
		
2D map	Photo	Photo
		
Text	3D rendering	Text