Understanding and improving decision-making for brownfield redevelopment in China

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Declaration

I declare that this thesis is my work and has not been submitted for the award of a higher degree or qualification at this university or elsewhere.

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Abstract

With the rapid urbanization and industrial reconstruction in China, an increasing number of industrial sites have been abandoned and remain as brownfields. Brownfield redevelopment has become an emerging issue for urban sustainable development.

By reviewing the urbanization history and decision-making process for city planning in China, the key factors are identified as city planning policies, economic development, and city planning process. After discussing the current consideration of brownfield redevelopment in the decision-making for city planning, some critical challenges are recognized, e.g., short-term decision-making process for city planning, time-consuming and multi-level city planning for brownfield redevelopment, poor brownfield data , lack of strategic regulations for brownfield redevelopment, and minimal power of brownfield redevelopers in city planning. Accordingly, this PhD project hypothesizes a strong correlation between city planning and brownfield redevelopment, limited consideration of brownfield redevelopment in city planning, and some key influential factors restricting the consideration of brownfield redevelopment in city planning. This work aims to find the mechanisms causing these challenges and offer potential solutions.

To obtain sufficient data addressing these research objectives and testing hypotheses, both quantitative questionnaires and qualitative interviews were carried out to access key stakeholder groups. To design suitable questions, a pilot survey was conducted to test the viability of question sheets. A formal survey was subsequently carried out from March 2018 to June 2018 to collect data from participants belonging to different cities or different stakeholder groups, including city planners, brownfield redevelopers, and third parties. Three target cities (Shenyang, Guangzhou and Wuhan) were selected to represent different conditions of industrialization and development in China.

In total, 196 participants took the formal survey, including 88 in Wuhan, 54 in Guangzhou and 54 in Shenyang. Of them, 63 participants were city planners, 73 were brownfield redevelopers, and 61 were members of third party. Cronbach's coefficient alpha (0.787) and λ in Guttman split-half reliability (0.608) suggest a satisfactory reliability of questionnaire results. Sixty-six participants took the qualitative interview, and 21 of these interviews were selected for further analysis.

Results from the quantitative questionnaire suggested, although there is agreement between all stakeholder groups, they have different opinions towards their respective roles in the decision-making process for either city planning or brownfield

redevelopment. City planners regard the city plan as the main driving force for brownfield redevelopment, whereas brownfield redevelopers and members of third party take sustainable development as priority. City planners are aware of city planning procedures, but have limited understanding of brownfield redevelopment and underestimate the roles of brownfield redevelopers in city planning process, whereas brownfield redevelopers and members of third party hold the opposite opinion. Additionally, participants from different cities have distinct opinions for different economic development levels. Participants in Guangzhou with a higher economic development level tend to regard economic development and the city plan as relatively more important than other driving forces and view city planners with more roles in both city planning and brownfield redevelopment. Whereas, participants in other cities (Shenyang and Wuhan) prefer more involvement of brownfield redevelopers. Generally, there is a strong correlation between city planning and brownfield redevelopment, both affected by similar driving forces, showing the necessity to consider brownfield redevelopment in the decision-making for effective city planning.

Results of the qualitative interviews are consistent with questionnaire and further summarize the deeper understanding of participants on the current situation and driving forces for considering brownfield redevelopment in the decision-making process for city planning. In fact, most participants have realized the limited roles of brownfield redevelopers and third party in either the city planning or the brownfield redevelopment process, and pointed out that improving involvement of brownfield redevelopers in the decision-making process for city planning is urgent and an effective approach for better design of city plans and sustainable brownfield redevelopment.

In summary, current city planning in China is at the stage of ‘extensive development mode and lack of effective environmental supervision’. Brownfield redevelopment in China has many challenges, and there is limited consideration of brownfield redevelopment in the decision-making process for city planning. It is caused by the multiple planning systems and lack of brownfield databases. Moreover, there is unclear division of responsibility between stakeholder groups, i.e., insufficient involvement of brownfield redevelopers in city planning, limited participation of the public. To better consider brownfield redevelopment in city planning, new decision-making regulation frameworks and brownfield databases are suggested. Additionally, mechanisms need to be established to encourage the involvement of brownfield redevelopers, third parties and the public in the decision-making process for city planning.

Content

1. Introduction

1.1 Urbanization and city planning

An urban area is a place with a high density of human population, built environment and social activities, compared to the surrounding rural area. The definition of 'urban' varies from country to country. The United Nation defines 'urban' as "any settlement with at least 2,000 residents", similar to the definition in most of the countries in Africa. In Nigeria, the urban area refers to towns with 20,000 or more inhabitants, whereas in Latin America, the threshold of urban population is 100 or more dwellings. Due to the large population, the definition of urban is more diverse in Asian countries. For instance, the definition in India is a town with municipal administrative bodies, while 50,000 inhabitants are the minimum urban population in Japan.

From only 746 million people living in urban areas in 1950, the global urban population rose to 3.42 billion in 2009 and 3.9 billion in 2014, surpassing that in rural areas (3.41 billion in 2009 and 3.25 billion in 2014). From the prediction of the Population Division of the United Nations Department of Economic and Social Affairs, the global urban population will grow to 6.4 billion by 2050 and the majority will be in developing countries, including China. Such high population migration from rural areas to urban areas results in urban expansion and an increasing realization of the importance of interconnectedness and complexity in urban areas. Thus, city planning is developed to manage effectively in urban areas - not only for residential areas, but also public facilities like transport, infrastructure (Levy, 2015). Many land use allocation problems are associated with the demands of different stakeholders, with city planning often urgently required to manage the urbanization process effectively in many cases.

1.2 Brownfield and brownfield redevelopment

Urbanization is always facing the problems of redeveloping used or abandoned sites. Sometimes such previously used land is defined as 'brownfield'. Brownfield, or contaminated land, has two similar definitions both from developed countries. The Concerted Action on Brownfield and Economic Regeneration Network defines brownfield as sites that "*have been affected by the former uses of the sites and the surrounding land; are derelict or underused; have real or perceived contamination problems; are mainly in developed urban areas; require intervention to bring them back to beneficial use*" (Rizzo et al., 2015). This concept is mainly applied by environmental

managers in the European Union (EU) and guides their redevelopment and regeneration activities. In America, contaminated land is "*a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant*" a defined by US Environmental Protection Agency (USEPA, 2015, pp. 3-4). Chinese authorities have borrowed this as a common expression for their administration. With some common and key components, often formerly used sites, require redevelopment, with or potentially with hazardous pollutants. Numerous brownfields can be found in urban areas, including abandoned factories or commercial buildings. Typical contaminants include hydrocarbons, organic solvents, pesticides and heavy metals, which are all toxic substances threatening the ecosystems and human health. Accordingly, these brownfields bring challenges when they are redeveloped for new functions in urban areas.

1.3 Brownfields in China

The economic structure in China has changed enormously over the last thirty years, as well as the land-use patterns in Chinese large cities (Chen et al., 2008). Land is increasingly needed for urban growth, rather than farming, to support the extensive industrialization and urbanization (China Council for International Cooperation on Environment and Development (CCICED, 2010). City planning has therefore significantly developed in the last decades. However, there are limited land resources for urban expansion in China, due to the huge population. The demand of reusing or redeveloping abandoned sites within urban area has increased. During such rapid urbanization process, many brownfields require assessment and possible remediation before reuse. However, China has the special situation that brownfield redevelopment has not been well considered or developed until now. Only the central or local administration, of all the authorities, has ownership of the land resources and is responsible for land use allocation. The Ministry of Land and Resources (MLR) is involved into the process of planning, designing, making decision, utilizing land etc., but the participation of other relevant authorities (stakeholders) is often not part of the process to identify and evaluate brownfield redevelopment. It is therefore important to identify whether brownfield redevelopment should be comprehensively integrated with the regeneration process of city planning at the first stage. This could increase the effectiveness of decision-making processes and help minimize costs during the city planning process.

1.4 Challenges in considering brownfield redevelopment in the city planning process

It is relatively easy to make decisions in city planning for brownfield redevelopment when the decision-making process is well-developed and the pace of urbanization is slow. In China, however, urbanization is occurring at a rapid pace and the decision-making process are still under development. The Chinese government is facing greater challenges in sustainable city planning to provide sustainable and high-quality living for its inhabitants. The city plan therefore should consider urban sustainability and brownfield redevelopment. Currently, there are some obvious defects in Chinese soil management and redevelopment, such as: inadequate monitoring systems, an incomplete legislation system, overlapping of competencies in site administration, and the lack of a dedicated funding scheme (Brombal et al., 2015). It is therefore important to identify the challenges or factors restricting the consideration of brownfield redevelopment during city planning process and then raise new systematic strategies for effective brownfield redevelopment in China, regarding the rapid urbanization, huge amounts of brownfields to be redeveloped, and incomplete list of brownfields. It is also necessary to bring some deeper understanding and new insights into the relationship between city planning and brownfield redevelopment in China, with more focus on both theories and practices, to help develop successful strategies and policies, in the move towards more sustainable urbanization.

1.5 Thesis purpose and approach

The close relationship between city planning and brownfield redevelopment has drawn much attention in recent years. How to make appropriate decisions for city planning and consider brownfield redevelopment during the city planning process, with the demanding challenges of rapid urbanization in China? The purpose of this project was to help address this question.

The approach taken was to survey decision-makers and other stakeholders/participants in the city planning process and obtain their opinions on how brownfield redevelopment is currently operating in China and how it should be considered during city planning process. The intention is that the project will help provide a clearer vision about brownfield management in China and contribute to effective consideration of brownfield redevelopment during the decision-making process for city planning.

Specifically, the primary objectives of the project were:

[1] To identify the relationship and contradictions between city planning and brownfield redevelopment.

[2] To understand the changing situation and process of decision making in city planning, with respect to the dynamic policies and regimes in China.

[3] To understand better the actions of decision-making for city planning related to brownfield redevelopment and management and how they can affect the brownfield redevelopment process.

[4] To explore how the decision-making process for city planning can be improved to address brownfield redevelopment.

To achieve the research objectives, a questionnaire and an interview were conducted between March and September in 2018 in three major cities in China. The participants included city planners (decision-makers for city planning), brownfield redevelopers (decision-makers for brownfield redevelopment) and members from third parties (those involved in both the decision-making process for city planning and brownfield redevelopment).

1.6 Thesis structure

The thesis consists of eight chapters. Chapter 2 is a critical review of the decision-making process for city planning and the challenges in brownfield redevelopment, drawing on experiences in western countries and China. The strong link between city planning and brownfield redevelopment is discussed. The questionnaire and interview were then designed in Chapter 3 to collect information from decision-makers and key participants for city planning and brownfield redevelopment. After evaluating the survey quality in Chapter 4, the results of survey questionnaire and interview are then presented and analyzed in Chapters 5 and 6, respectively. Both chapters aim to identify the current situation and challenges of considering brownfield redevelopment during decision-making for city planning from survey results. In the following Chapter 7, the survey results are then comprehensively analyzed and discussed to make suggestions on how to improve strategic brownfield redevelopment against the backdrop of China's rapid urbanization. Chapter 8 summarizes the main findings of this research and concludes the research outcomes and suggestions.

Chapter 1 has briefly set the context by introducing the definition of urbanization, city planning and brownfield redevelopment, and current brownfield redevelopment in China. It is proposed that decision-making for city planning should be strongly correlated with brownfield redevelopment. In general, future land-use of brownfield is determined by city planning; however, brownfield redevelopment is given only limited consideration during the decision-making process for city planning in China. To realize the challenges in considering brownfield redevelopment during decision-making process for city planning, Chapter 2 comprehensively reviews the key components in decision-making for city planning and brownfield redevelopment, recognizing how they are linked together in China regarding rapid industrialization and urbanization. The practical processes and decision-makers for city planning and brownfield redevelopment are identified and discussed, recognizing city planners, brownfield redevelopers and members from third-party as the key players for both processes. Chapter 2 also discusses the challenges in considering brownfield redevelopment from political, economic and management perspectives. The literature review in this chapter suggests six main challenges, namely:

1). rapid urbanization and decision-making process for city planning;

2). limited efficiency in considering brownfield redevelopment in city planning process owing to the multi-level city planning;

3). minimal power of brownfield redevelopers in decision-making for city planning;

4). poor brownfield data availability for effective consideration of brownfield redevelopment;

5). lack of strategic regulations for brownfield redevelopment;

6). confusion in selecting remediation strategies for brownfield redevelopment.

New policies and regulations are being developed and applied to better manage soils/land resources in China, but these are new and may not be fully understood, applied or effective at this time. This highlights the importance of a survey to better understand what is known, understood and happening in practice – by directly collecting the opinions of key players for city planning and brownfield redevelopment and exploring any problems and potential solutions.

Chapter 3 then gives details of the research methods applied in the thesis, including the

selection of survey approach, design of questionnaire and interview questions, the data collection process and data analysis methods. The strengths and weaknesses of quantitative questionnaire and qualitative interview approaches are discussed and a decision made to combine the two approaches together, to obtain more evidence about the opinions of city planners, brownfield redevelopers and members from third-party on the current and to seek opinions on the ideal situation to consider brownfield redevelopment during the city planning process. The selection of participants, based on their key roles in decision-making processes for city planning is discussed, as well as the choice of cities, in accordance with their industrial development history. Data analysis methods are also described in this chapter.

Chapter 4 evaluates the data quality of both the questionnaire and interview surveys. This is critical to assessing the credibility and validity of the data gathering process, informing which questions and approaches yield useful information and how it can be interpreted. Additionally,

Chapters 5 and 6 present and discuss the results from the quantitative questionnaire and qualitative interviews, respectively, to summarize the main findings of this research. The results are discussed with respect the views of the different stakeholder groups and the different cities.

The questionnaire yields differences in opinions are identified for city planners, whereas brownfield redevelopers and members from the third-party have similar ideas about the current and ideal situation to consider brownfield redevelopment during city planning process. Although the results of participants from different cities do not show significant differences, some specific differences can be found for some questions. All the participants agree that brownfield redevelopment is only considered in a limited way during the decision-making process for city planning, which mainly focuses on economic development and infrastructure establishment. Brownfield redevelopment is only considered in a limited way during decision-making processes for city planning, and the restrictive factors, including rapid decision-making processes for city planning, limited databases for brownfields, insufficient cooperation between city planners and brownfield redevelopers, etc. Results from qualitative interview further confirm the findings from the questionnaire and provide deeper analysis of the reasons and consequences of these problems for further considering brownfield redevelopment in decision-making processes for city planning.

Chapter 7 briefly summarizes the main findings of this research and offers suggestions for the realistic decision-making framework for future city planning and brownfield redevelopment. A regulation framework is recommended to improve effective decision-making for city planning. It is proposed that brownfield information databases should be established for brownfield management. The involvement of brownfield redevelopers and members of third parties in the decision-making process for city planning should be encouraged and improvements in public awareness are also suggested. Chapter 8 presents the conclusions and recommendations for further work.

2. Literature review and research objectives

2.1 Decision making for city planning

2.1.1 Brief history of global urbanization

From archaeologists' perspective, urbanization means the transformation from small areas of human residences to larger areas, with comprehensive social and political functions via subsidiary centres (Ortman et al., 2014). The most accepted definition of urbanization is the process in which population shifts from rural areas to urban areas, consequently resulting in "the gradual increase in the proportion of people living in urban areas". Predominantly, the urbanization process is the formation and expansion of towns and cities as more people live and work in central areas, numerically more than 5,000 inhabitants. Urbanization is associated with a wide range of disciplines, including geography, sociology, economics, city planning, and public health.

The appearance of the first cities can be tracked back to between 6000 and 5000 B.C., but the first growth of urbanization was from Mesopotamia and Egypt (3000-500 BC), when social division caused a small population who were involved in economic activities in towns, instead of those engaged in agricultural activities in rural areas. The formation of markets and workshops gradually led to increasing areas of towns between 600 B.C. to 400 A.D, maintaining a balance between urban and rural populations, until the Romans who developed the functions and services in urban areas to support populations of several hundred thousand people. After the Dark Ages (400-1000 A.D.), when civilization was postponed, the bloom of urbanization occurred in many European countries, and some famous urban areas became centres of trade and transport, including London, Venice, and Frankfurt.

Urbanization is one of the key characteristics of European civilization (Antrop, 2004). Since the industrial revolution in 18th century, urban areas became the most important and vibrant for economic activities and a true urbanization revolution took place. The urbanization rate in England had a dramatic increase from 17% in 1801 to 72% in 1891; it was 37% in France, 41% in Germany and 28% in the USA around this time. Afterwards, increasing global urbanization rates were observed for every 50 years, as 132% (1800-1850), 193% (1850-1900) and 240% (1900-1950). In 1950, the number of people who lived in urban areas was 313.7 million, with around 900 cities of 100,000 or more people. Since then, an accelerated urbanization rate has been observed and over

50% of the world's population now live in urban areas, likely rising to 68.7% by 2050, according to World Urbanization Prospects (Figure 2.1).

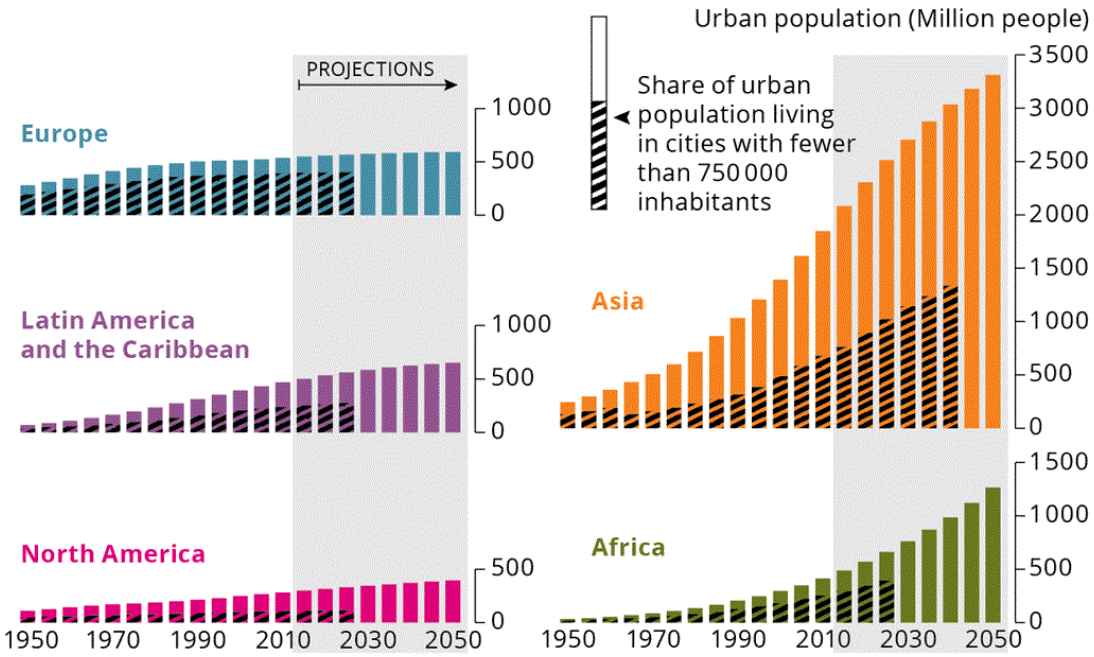


Figure 2.1 Global urbanization trends by regions from 1950 to 2050 (UNDESA, 2011).

Figure 2.1 also illustrates a significant difference in urbanization levels across geographic regions, particularly between developed and developing countries. The urbanization rate in Europe and North America has slowed remarkably since the 1970s. Globally the high urbanization rates (>75%) are now in Western Europe, America, Australia and Japan (Figure 2.2). Currently in most European countries, >70% of the population already live in urban areas (Kabisch and Haase, 2013), and there are only limited areas with the trend of increasing urban land cover (Antrop, 2004). For example, two new urbanization areas are located in Swindon (Wiltshire) and Milton Keynes (Buckinghamshire) in the United Kingdom. As for developing countries, urbanization is still progressing and the urbanization rates are expected to increase from current 10%-50% (Figure 2.2) to above 75% in the next decade. Rapid urbanization is therefore now a worldwide phenomenon in developing countries.

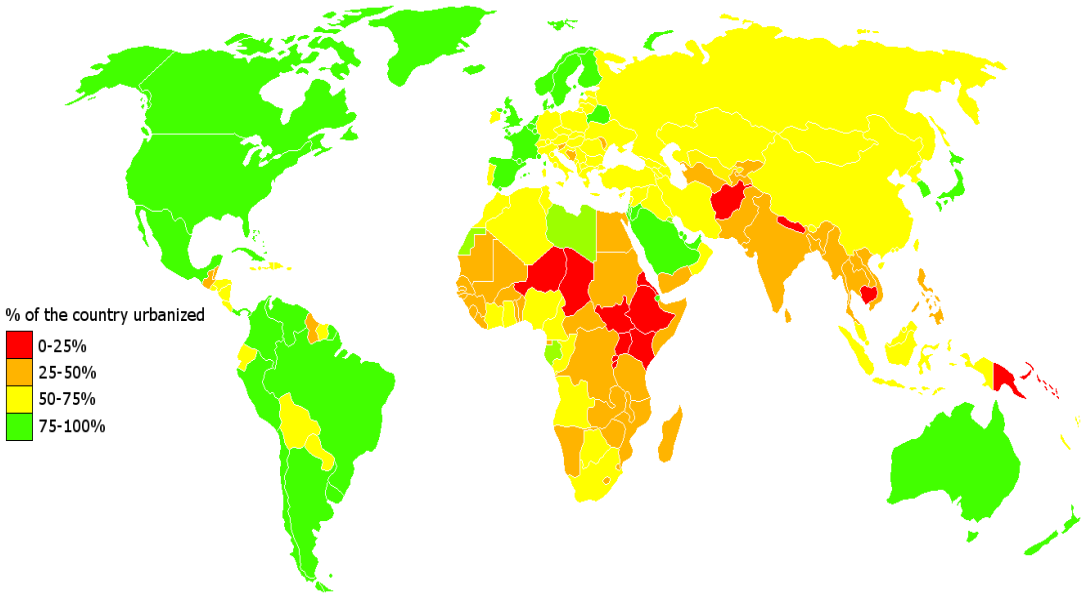
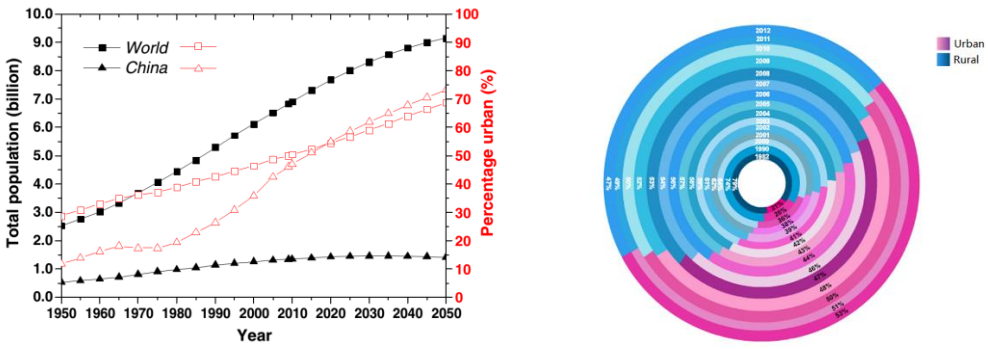


Figure 2.2 Current urbanization rates in different countries. Urbanization rate (α, %) is a key factor used by social scientists to evaluate the progress of urbanization and defined as the proportion of urban population (U) to the total population (T) and expressed as $\alpha = U/T \times 100$.

2.1.2 The urbanization process and situation in China

The urbanization process in China has been increasing at an unprecedented pace over the last three decades; it is now predicted to continue at a slower rate over the next 50 years. China's New Urbanization Research Report pointed out the six distinct stages of the Chinese urbanization process as: initial urbanization (1949-1957), tortuous development (1958-1965), stagnation (1966-1978), urbanization recovery (1979-1984), steady development (1985-1991), and rapid urbanization (from 1992 till now) (CURI, 2016). From 1949 to 1978, the number of Chinese cities slightly increased from 132 to 193, with the urban population accounting for 7.3% and 17.9% of the total population, respectively. Rapid urbanization occurred from 1979 to 2008, when the urbanization rate reached 45.7% and the urban population was 670 million in 655 cities, including 122 cities with populations over 1 million and 41 cities more than 2 million. Since then, from 1993 to 2012, Chinese urbanization has had a dramatic increase owing to the "Reform and Opening" policy. The total urban area has increased from 44 million hectares to 111 million hectares during this period, and the urbanization rate was significantly higher than the global level (Figure 2.3A).



(A) (B)

Figure 2.3 (A) Rapid urbanization rate in China compared to global urbanization rates (Kabisch and Haase, 2013). (B) Annual urbanization rate in China since 1982. Redrawn from Chen et al. (2016).

The proportion of people living in urban areas in China reached 50% for the first time in 2010 (Figure 2.3B), representing a critical stage in the Chinese urbanization process (Chen et al., 2016). Currently, the urban population is expected to be 1.0 billion, with the majority of citizens living in mega cities or urban agglomerations. Thus in 2013, "*Analysis of the Urban Land Use Data Aggregation Results*" issued by China's land survey considered the current development level and population in China and suggested that the urban population in one city normally needs to be over 3 million to provide sufficient public services and support satisfactory living conditions. Accordingly, the Chinese national plan points out that 50 more mega cities will be developed to solve the uneven distribution of China's population and concerns about the rapid urbanization process, regarding human health and wellbeing (Luo et al., 2012).

2.1.3 City planning

City planning is one of the important strategies for government to regulate urban land resources, guide urban and rural development and construction, maintain social equity, and secure public safety and public interests (Watson, 2009). Generally, city planning includes two stages: master planning and regional planning (Fainstein, 2005). Master planning proposes the strategic development for urban and rural areas at city-level by analyzing urban functions, setting development goals etc. It also determines the ecological environment, land and water resources, energy, natural and historical cultural heritage protection, etc. Additionally, the comprehensive objectives and protection requirements of city development are also raised by the master plan. By predicting the

total population and urbanization level, the master plan guides the population size, spatial layout, construction standards and traffic development. Some examples can be found in Beijing (Liu et al., 2014a) and Guangzhou (Tian and Shen, 2011).

Regional planning is the extension and refinement of the master plan, divided into the control plan and construction plan. The regional control plan mainly determines the main uses, building density and height, floor area ratio, green space rate, infrastructure and public service facilities. Generally, the regional control plan determines the boundaries of lands with different uses within the planning area, and the types of buildings that are suitable for construction. In contrast, the regional construction plan mainly involves the specific implementations of city planning, particularly the analysis of construction conditions and spatial layout. Besides the comprehensive consideration of municipal buildings such as houses, hospitals and schools, the histories of abandoned sites are also included for their appropriate redevelopment, particularly for brownfield sites.

By analyzing the details of city planning at different stages, it is concluded that the key considerations of city planning include urban form, land use layout, transportation system, municipal infrastructure, and environmental protection. However, activities related to environmental protection in either the master plan or the regional construction plan mainly focus on the environmental capacity to maintain the balance between urban economic development and environmental planning. Brownfield redevelopment and management is often not considered.

In western countries, city planning has been well developed and structured, and city planning strategies can be found in many cases. It is currently dominated by eight procedural theories for effective city planning processes, including: the rational-comprehensive approach, incremental approach, transactive approach, communicative approach, advocacy approach, equity approach, radical approach, and humanist or phenomenological approach. Each theory is grounded from different aspects in urban land use, but similar stakeholders are considered. Public participation is also suggested in city planning to strengthen social interactions (Bugs et al., 2010). Nowadays, sustainability objectives are central to modern city planning (Greed, 2016). From Campbell's contradictions between city planning and sustainable development, the three triangle points in city planning include economy, environment, and equity (Campbell, 1996). He suggests that city planning should balance the three components

to mitigate the conflicts of property, resource and development.

2.1.4 Decision-making process and decision-makers for city planning

For the complexity in city planning, decision-making is viewed as an important step in city planning process. For more than two decades, numerous studies have been carried out to develop appropriate decision-making process for city planning (Stevens et al., 2007). For well-developed decision-making processes for city planning, all the stakeholders behave as decision-makers together for city planning with respective roles and many researchers have developed models for effective decision-making for city planning (Awasthi et al., 2011). Normally, these key decision-makers include policy makers, city managers, planning experts and the public. They hold different opinions towards the city plan from their own perspectives.

Policy-makers direct the future functions of the whole city which serves the people living in the urban area, but also the economic purpose regionally and nationally; they set up the strategic policies to ensure its direction. They therefore propose the overall requirements and basic principles in the city plan, but normally not involving specific land uses, such as brownfield site re-development.

City managers focus on the detailed requirements and development goals from their own perspectives, according to their specific governmental roles. Normally, city managers do not have brownfield information in urban areas, and there is no department directly responsible for brownfield redevelopment.

The roles of planning experts are to practically design the details related to all the aspects in city planning, considering the respective requirements at different levels of city planning. Currently, experts engaged in brownfield redevelopment should belong to this category of planning experts, but they are not actually the decision-makers of city planning, which can consequently leave a gap which neglects consideration of brownfield redevelopment during the city planning process.

The public is the ultimate user of the ‘products’ generated by city planning, and their interests and concerns related to city planning represent the value preference and appeal of urban populations towards city planning. From cases in the Netherlands, public-private partnerships have been encouraged in decision making during city planning processes (Nijkamp et al., 2002).

The Chinese decision-making process for city planning follows similar lines to western

approaches, but with some modification to match Chinese situation. Some new indicators are put into the models and approaches to assess current and proposed land use, including some recent cases documented for Jining City (Li et al., 2009) and Hong Kong (Shen et al., 2009). Different dynamics and regulatory approaches can also be found in Chinese government.

2.1.5 Key factors affecting decision-making for city planning

Decision-making for city planning is affected by the various driving forces led by different decision-makers mentioned above, such as policies for city planning and future city functions (policy-makers), the economic situation and sustainable development (governmental officers), and the planning process (planning practitioners).

Policies and regimes are the first factor affecting decision-making for city planning from policy-makers' point of view. For the rapid urbanization over the last 30 years in China, city planning must be updated every 10 or even 5 years to meet the dynamics of the city area. Accordingly, policy makers set up a time-limited decision-making process for city planning, normally 15 days. Within such a short period, only key issues can be considered for city planning, whereas some less important or time-consuming factors have to be weakened or even ignored during the decision-making process, *e.g.*, brownfield situation. Additionally, future city functions, which determine the land use and zoning in the urban area, also change dynamically, owing to the rapid urbanization process. It challenges the redesign of future land use. In such situations, decision making should consider the spatial and temporal variation in urban areas, and sometimes take ecosystem services into account, to evaluate the synergistic impacts arising between climate and land-use change (Bateman et al., 2013).

Secondly, the economic situation significantly affects city planning. The prime districts and outer areas have different values, for example, and their planning is therefore significantly affected by economic factors. Rapid urbanization enhances the importance of economics. For instance, city planning in Italy has evaluated the values of land use and classified them into different categories, as key indicators to assess the ecosystem service for strategic spatial city planning (Scolozzi et al., 2012).

Planners and buyers are also important participants in the decision-making process for city planning, and they have to adapt to such rapid decision making and introduce more practical indicators to make decisions in shorter time-frames. For example, some urban

sustainability indicators have been selected to help in rapidly determining strategies and policies in city planning (Shen et al., 2011).

2.2 Brownfield and brownfield redevelopment

2.2.1 Soil contamination and brownfield

The long history of urbanization consequently resulted in many brownfields in western countries. Elevated concentrations of potentially harmful heavy metals were found in the UK, such as As, Cd, Cr, Hg, Ni, Pb, V and Zn derived from industrial and mineral processing, power generation and atmospheric deposition (De Sousa, 2003). Intensive investigations have been widely carried out on the distribution of heavy metals in the urban soils of many European cities, where the main sources of heavy metal contamination are often from industry. Pb, Zn are Cu are identified as "urban metals" with strong internal correlation, and it is similar for Ni and Cr named as "non-urban metals" (De Sousa, 2003). The Geochemical Survey of Urban Environments (GSUE) project therefore provides information for heavy metal elements, except Hg. The results of surface soil contamination from fourteen urban centres (Table S1, Appendix 1) present the most comprehensive urban contaminant situation in UK. The median concentrations of Cr are highest in Glasgow and Sheffield, which are known for intensive ore processing and steel-making industries. Meanwhile, Lincoln and Mansfield have relatively low contamination of As, Cr, Ni and Pb compared to other cities, for example, attributed to their small and less industrialized urban centres.

2.2.2 Brownfields in China

Cities and rural areas in China are facing serious land pollution problems (Wu et al., 2018). Since the 1950s, with the beginning of China's industrialization and modernization process, a large number of industrial polluted brownfields have emerged in cities of China, but their detailed number is still unclear due to the lack of overall statistical databases. The formation of brownfields can be traced back to the construction of highly polluting industrial enterprises, before the founding of the People's Republic China, when most industrial factories were built in the peri-urban areas. These old enterprises with a long history of production and relatively backward equipment and technology have extensive management and lack of environmental protection facilities, thus often leading to serious soil pollution. Some brownfields are polluted at levels which exceed the relevant regulatory standards. Determining the

surface and depth distribution is challenging and can affect the extent, cost and type of remediation or land use options. Some organic pollutants can be concentrated in underground soil layers as the form of Non-Aqueous Phase Liquids (NAPL), thus become new sources of pollution. Some pollutants can migrate to groundwater and diffuse to cause more widespread problems.

According to the *Analysis of Restoration and Redevelopment of China's Brownfields* by the World Bank, China's urban brownfields can be roughly divided into the following four types if classified as major pollutants:

Firstly, heavy metal polluted brownfields. This type of brownfield mainly comes from iron and steel smelting enterprises, tailings and storage sites of solid waste in the chemical industrial factories. Representative pollutants include arsenic, lead, cadmium and chromium, which can be found at high concentrations in soils in many Chinese cities (Table S2, Appendix 2).

Secondly, brownfields polluted by persistent organic pollutants (POPs). Some pesticides have been produced and widely used in China, *e.g.*, DDT, hexachlorobenzene and chlordane. Some of them still have residues in the soil after being banned for many years. That is why there are many pesticides polluted sites in China. Additionally, there are also many brownfields polluted by other types of POPs, such as sites for sequestrating and dismantling electrical equipment containing polychlorinated biphenyls (PCBs).

The third type of brownfield is polluted by organic pollutants mainly from petroleum, chemical and coking industry. The representative pollutants are organic solvents, such as benzene, volatiles and halogenated hydrocarbon. This type of brownfield often has mixed pollutants, including heavy metals.

The fourth type is brownfield polluted by electrical wastes. Contaminants in such sites can include heavy metals and POPs including brominated flame retardants and dioxin-like highly toxic substances.

In addition, in order to investigate the current situation of land pollution in China, in 2006, the former Ministry of Environmental Protection (MEP, now Ministry of Ecology and Environment, MEE) and MLR jointly launched a survey on the state of soil pollution and its preventive measures, with an investigation fund of 1 billion RMB. According to the *National Soil Pollution Status Survey Bulletin* published in 2014, the

overall soil environmental conditions in China are not optimistic with heavier pollution in some areas, worrying soil quality of cultivated land and prominent soil environment problems in industrial and mining wasteland. The total over-standard rate of soil sample locations was 16.1%, of which the proportions of slight, mild, moderate and severe pollution were 11.2%, 2.3%, 1.5% and 1.1% respectively. From the perspective of land use types, the over-standard rates of cultivated land, forest land and grassland were 19.4%, 10.0%, and 10.4%, respectively. From the perspective of pollution types, inorganic forms were dominant, organic forms the second, and the proportion of composite pollution was small. The number of over-standard inorganic polluted points accounted for 82.8% of all over-standard soil points. As for pollutants, the over-standard rates of eight inorganic pollutants - cadmium, mercury, arsenic, copper, lead, chromium, zinc and nickel were 7.0%, 1.6%, 2.7%, 2.1%, 1.5% and 1.1%, 0.9%, 4.8%, respectively; the over-standard rates of hexachlorocyclohexane, DDT and polycyclic aromatic hydrocarbons were 0.5%, 1.9% and 1.4%, respectively. The report pointed out that soil environmental quality is affected by multiple factors, and soil pollution in China is accumulated in the long-term process of economic and social development. Human activities such as industrial and mining, agricultural production, and high natural backgrounds (for geological reasons) are the main causes of soil pollution or exceedance of soil pollutant standards.

In recent years, some serious land pollution incidents have occurred in the process of rapid urbanization and brownfield redevelopment in China. Some of these incidents have drawn the public's attention after being reported by the media. For instance, the poisoning event of construction workers in the Songjiazhuang subway project in Beijing in 2004 has become a key event that attracted attention to the environmental risks of redevelopment of brownfield at the national level. In the year as when the "Songjiazhuang Incident" occurred, the former State Environmental Protection Administration released a notice to require local environmental protection departments to implement prevention and governance of environmental pollution during the process of enterprises relocation. It is now necessary to report to the General Administration in good time and to formulate an implementation plan to control pollution as soon as possible, once soil pollution problems are discovered.

2.2.3 Brownfield management strategies

With increasing attention on brownfield sites, many national governments have set up

regulations for brownfield management. Brownfield management therefore becomes an important activity, with a number of participants or stakeholders, including the environmental protection agency (EPA), local government, land users, land owners, and third parties, etc. Based on the laws and regulations, brownfield management should follow a series of the routine steps, similar as other environment management responsibilities. These include site investigation/ identification, selection/investigation, evaluation, design, monitoring and possible remediation.

In the USA, the state EPA take the main responsibility for the investigation and cleanup of brownfields, cooperating with state EPAs. Together with other national and local government actors, the EPA can provide technical help and even some funding to evaluate, remediate and re-evaluate brownfield sites. The situation of brownfield management is slightly different in the UK. The Part IIA of the Environmental Protection Act 1990 is the main regulation for brownfield management. Instead of central government, local authorities are responsible to prepare a list of contaminated land sites/registrations, which will be considered and implemented in planning applications. The register identifies sites which potentially have past and present contamination. All these brownfield sites then need site data and a risk assessment processes, addressing potential sources, pathways and receptors for pollutants at the sites. From a survey of Romanian stakeholders, the attitudes of stakeholders are were shown to have essential roles in brownfield management, and it was suggested to improve stakeholder awareness for effective management (Stezar et al., 2014).

2.2.4 Brownfield management and redevelopment

To manage brownfield redevelopment, numerous financial and technical approaches have been innovated for brownfield remediation (Morris, 2003). Generally, brownfield redevelopment strategies are influenced by three key factors - site characteristics, land function and remediation techniques.

Contamination types and levels are the key features which determine the cost and suitable remediation techniques (Beames et al., 2015). When environmental enterprises design brownfield redevelopment plans and cleanup budgets, the contamination levels will be taken into consideration, which limits the remediation cost and strategies for proposed functions. Risk assessment and related data are required for evaluation to match the designed land use and cleanup cost.

The value of brownfield redevelopment is dependent on future land use and the social demands, since brownfields are always viewed as challenges or burdens for re-use, because of previous contamination. In China, the functions of brownfield after redevelopment is dependent on the future land use, usually defined in the city planning process and directly linked to the urban layout and master plan. In western countries, the situation is usually more ad hoc, with private land ownership often dictating site re-use. The change of land use will increase the values of land, which is dependent on the location and market rates of the sites (Leigh and Coffin, 2005). Therefore, site functions are important to promote brownfield redevelopment. Most brownfield redevelopment projects aim to transfer brownfield sites into commercial sites. Pittsburgh is a good case and also one of the most well-known for brownfield redevelopment in the USA (Evanko and Dzombak, 1997). Some successful examples can be found for redeveloping brownfields contaminated by former steel mills and transferring them into residential, shopping or offices. Those sites include the Carnegie Steel works, which was reconstructed into a commercial center in Homestead, a slag dump converted to residential area in Waterfront, a LTV Steel mill turned into a high-end entertainment complex, a steel mill site converted into the Pittsburgh Technology Center in Hazelwood, and a 17-hectare former rail stop into a waterfront center for commerce. Alternatively, some brownfields can also be transferred into crop lands for further agricultural production. Usually the crops grown are not for direct human consumption. Led by Michigan State University, a former industrial dump site was transformed into crop land, not only introducing phytoremediation to mitigate contamination levels, but also contributing to biodiesel production for economic purposes.

Remediation techniques are the approaches to clean brownfields; the choice of remediation methods selected is determined by the presence of contaminants, land characteristics, functions, time available for remediation practices and cost. For instance, both *hard redevelopment* and *soft reuse* can be applied for brownfield redevelopment. The former refers to the subsequent building or infrastructure on the site, such as residential housing and commercial centres, and the latter represents use without substantial construction, such as public parks or crop land (Cundy et al., 2013). Either approach can work, but the decision-making will consider the current situation of brownfield and potential risks after redevelopment. Meanwhile, *circular land management* is a new concept in brownfield sustainable development, which considers

the approaches to mitigate new brownfields and regenerate existing brownfields into clean land. The recent European HOMBRE project suggests that brownfield redevelopment should face the current and emerging societal challenges. *Circular land management* is therefore a new framework to take both clean land and brownfield into account, contributing to long-term land management (Bardos et al., 2016).

2.2.5 Key decision-makers for brownfield redevelopment

Government is the most important decision-maker for brownfield redevelopment. In the United States, federal and state governments are responsible for brownfield redevelopment, and local governments also have an important role in its practices. Federal government provides policy frameworks and funding sources for brownfield redevelopment, mainly through legislation and enactment of policies. In addition, the Federal government also establishes the Interagency Working Group for brownfield risk assessment and clean-up. More precisely, their main roles include infrastructure construction, financing, environmental protection, green space protection, land use management, and project execution. As for state governments, they are led by the US Federal EPA; they propose specific brownfield redevelopment plans according to the local situation, *e.g.*, Voluntary Cleanup Programs (Alberini, 2007) and Brownfield Programs (Bacot and O'Dell, 2006), and encourage the public to participate in brownfield surveys and governance. Thus, local government is a key decision-maker for brownfield redevelopment and can also co-ordinate the following engineering project. Firstly, they link the specific implementation of brownfield redevelopment with national and regional city plans. Secondly, local government is in charge of site investigation and risk assessment. They are also responsible for financial and legal issues related to brownfield remediation, such as the introduction of Tax Increment Financing (Sroka, 2016), Tax Abatement (Medda et al., 2012), Community Development Block Grant (Kahn, 2011) and General Obligation Bonds. Finally, local government usually manages the long-term and continuous monitoring of the site after remediation and redevelopment.

Brownfield redevelopers mainly include designers and executors for brownfield redevelopment projects, who have the main obligations for brownfield cleanup and the following reconstruction on site. As they have experience in brownfield redevelopment engineering, brownfield redevelopers should be familiar with different remediation strategies and can provide valuable suggestions towards decision-making for

brownfield redevelopment. Additionally, besides offering professional management of brownfield remediation, brownfield redevelopers also advance the long-term environmental stewardship, as 3-5 years' monitoring is required in many countries to secure the successful remediation and protect health of local residents. Accordingly, brownfield redevelopers have the responsibility to set up long-term monitoring program for brownfields after remediation or risk control practices.

Brownfield experts are important decision-makers for brownfield redevelopment, by offering suggestions to government and providing practical supports for brownfield redevelopers. They are mainly consisted of professionals from universities, advisors from research institutes and technicians from brownfield redevelopment enterprises. Their first roles in decision-making process for brownfield redevelopment are to consultancy for site investigation, risk assessment and survey. Serving as third parties, brownfield experts are able to provide objective suggestions on site investigation results, set up of remediation targets and selection of remediation strategies. Secondly, brownfield experts work as advisors throughout remediation practices and ensure the appropriate scheme and management during remediation activities.

2.2.6 Key factors affecting decision-making for brownfield redevelopment

Currently, the plan and design of brownfield restoration and redevelopment in urban area in China is still in its infancy, and there is lack of systematic theories or case studies providing standards to follow. Thus, most problems caused by brownfields or their redevelopment occur or are recognized during practical urbanization activities, after city plans have been prepared. In other words, policy makers have already decided city planning and future land use of each land block, before comprehensively identifying and characterizing brownfield issues through site investigation and risk assessment. Risk control and remediation engineering for brownfield redevelopment is therefore restricted by the planned land use, leading to serious problems such as responsibility attribution and budget gaps.

Decision-makers and decision-making mechanisms for brownfield redevelopment are different from city planning. Although decision makers for city planning are often involved in the decision-making process of brownfield redevelopment, those involved in the brownfield redevelopment process mainly include participants from environmental protection departments and brownfield experts, who are not involved in

the decision-making process for city planning. Decision-making for city planning usually follows the top-down mode, which sets the overall goal and then the details (Leshinsky, 2008). In this case, brownfield is usually not counted in decision-making for city planning, as it is one of the downstream issues to be considered. In contrast, brownfield management and redevelopment processes are normally bottom-up, when a specific site is redeveloped and the contamination problems are identified. Accordingly, small-scale changes of land use type or development mode are applied, instead of adjusting the city plan. It is therefore a challenge - How to systematically combine the decision-making process for both city planning and brownfield redevelopment?

In principle, considering and formulating a brownfield redevelopment plan during the city planning decision-making process can result in improvements to city planning efficiency and appropriate brownfield redevelopment. Suggested practices might include:

- the establishment of a specific brownfield redevelopment management department to participate in city planning process;
- integral decision-making regulations and processes for city planning and brownfield management;
- a well-developed mechanism for brownfield risk classification and communication to understand and update brownfield information;
- regulated pipelines to consider brownfield redevelopment at the beginning of city planning;
- synchronizing city planning and site management together throughout city planning process;
- and involvement of brownfield experts in decision-making process for city planning to proactively plan and control the risk management and remediation strategies for brownfield redevelopment.

There is a clear need for enhanced intelligence to support inter-participant decision-making for city planning and many practices have been attempted. For instance, the EU funded an URBIS project, investigating vacant land potential in urban areas, and the opportunities for previously developed land or brownfield to support city planning and regeneration (Ludlow and Soukup, 2015). To achieve sustainable planning, URBIS

delivers methods and tools to assess urban vacant land use and provide accurate up-to-date data on brownfields across European cities, allowing for an improved decision-making process for city planning regarding brownfield redevelopment issues.

2.2.7 Brownfield redevelopment in China

Since 2004, former Chinese MEP (now MEE) has also carried out a series of related work as the national level:

1) Setting up an established monitoring and management system for soil pollution prevention and control;

2) Issuing a number of policies and laws on soil pollution prevention and control;

3) An improved standard system for prevention and control of soil pollution and monitoring network for the soil environment;

4) Establishing an emergency plan for soil pollution accidents;

5) Improving supervision ability for soil environmental protection and enhanced public awareness of soil pollution prevention;

6) Promoting development of new technology for soil pollution prevention and control, and demonstration projects of contaminated soil remediation and comprehensive treatment.

After more than ten years, the development of polluted site management ideas and institutional frameworks in China has gradually become clearer, and the strategy, institution construction, responsibility determination and technical method framework for the whole process of brownfield management have basically been clarified. The 10-year process to construct the legislation and standards system for soil pollution prevention can be divided into two stages.

The initial stage of system construction was from 2004 to 2011. In 2004, the State Environmental Protection Administration issued the environmental management requirements for the relocation and reconstruction of enterprises, which began the route to environmental management of brownfields in China. In 2008, the *Opinions on Strengthening Soil Pollution Prevention and Control* was formulated. In 2009, the *Interim Measures for Soil Environmental Management of Contaminated Sites (Draft for Comment)* and *Administrative Measures for Assessment and Restoration of Industrial Polluted Sites (Draft for Comment)* were formulated, to explore the construction of soil

pollution prevention and control systems. Although the drafts of soil environmental management measures in 2009 were published and consultations conducted, they were not officially released due to a lack of consensus and immature timing. During this period, in order to meet the needs of the Shanghai World Expo to revive the land environment, Shanghai formulated the *Evaluation Standard for Soil Environmental Quality of Exhibition Sites (Provisional)* (HJ350-2007).

There was then an acceleration period from 2012 to present. The problems of contaminated sites have been emerging across the country, with concerns about human health impacts of increasing concern to the public. International experiences with polluted sites management, lessons and development trends have helped promote China's understanding of environmental management of contaminated sites, and the management system has developed significantly. During the "Thirteenth Five-Year Plan" period, with the promulgation of *the National Soil Pollution Prevention and Control Action Plan* and soil pollution prevention and control laws, the construction of soil environmental protection, pollution prevention and control systems have entered a more stable period, during which the institutional system has become more mature and better implemented.

2.3 Relationship between city planning and brownfield redevelopment

2.3.1 City planning affects city development and strategic brownfield redevelopment by determining future land use

Accompanied with urbanization, city planning is becoming an important and attractive topic in social science and engineering. As urbanization has become a global phenomenon, city planning which directs urbanization shows greater impacts on our social life, designing not only the location where human beings are living, but also their work and life. Urbanization also influences the surrounding rural areas. Urban areas are also centres for many social activities and relationships, such as economy, policy and social relationships. City planning determines the layout of urban areas by considering city functions and affects the efficiency of the city. Last but not the least, as significant urban dilemmas occur when the urban population is over 16 million or even 50 million in an urban agglomeration (within 200 km), environmental problems such as municipal waste treatment, transportation, housing and employment challenge the city development and require solutions to avoid serious problems, *e.g.*, slums.

Although different frameworks can be found in many counties, the classic decision-making process mostly emphasizes land development, but brownfield redevelopment is often neglected (Pauleit and Duhme, 2000). Sustainable accessibility is viewed as an important factor affecting decision-making for city planning (Curtis and Scheurer, 2010). It requires data of high spatial resolution to identify the distribution and features of brownfield sites, to establish their relationship within urban areas and to evaluate their social or economic impacts on urban functions. City planning and urban development without brownfield redevelopment might address the priority of urban functions and further expansion, but when sustainability and brownfield are taken into account, it is necessary to bring more factors into the decision making process to critically evaluate the impacts and further consequences of brownfield redevelopment (Flores et al., 1998; Kenworthy, 2006).

2.3.2 Roles of brownfield redevelopment in directing future land functions and city planning

As mentioned above, a wide range of contamination has been identified along with the rapid urban development in recent decades in Europe, caused by different sources and intensities of anthropogenic inputs (Huston et al., 2015). For example, the estimated total areas of brownfields in Belgium, Germany and the Netherlands are 145 km^2, 1280 km^2 and 110 km^2, respectively. They are valuable land resources to be remediated and redeveloped, contributing to more compact urban centres and to reduce the consumption of undeveloped green areas at the periphery. Since the 1940s, a significantly increasing number of abandoned industrial or commercial properties were found in urban areas, attributed to previous industrial and commercial activities. The definition and attraction of brownfield is raised together with city planning according to their values as land resources.

Brownfield redevelopment has raised a series of environmental challenges. For instance, during brownfield redevelopment process, the efficiency of brownfield redevelopment was seriously restricted by the planned land use, which determines the target and remediation strategies. When brownfield redevelopment is not cost-effective or the remediation target cannot meet the planned land use, brownfields must be reconsidered in city planning process.

A good example comes from British brownfield redevelopment history. The British government set up a target in 1998 that the rate of new house building would be raised by 60%and 4.4 million new houses would be constructed before 2016. Thus, the land types were considered before constructing new houses. Brownfield was then defined as an important land type, together with used green land and other urban land, to be considered for land redevelopment (Shephard and Dixon, 2004). In the late 1980s, brownfield had become a problem of high public concern, attracting the attention of policy-makers, city planners and researchers. Between 1988 and 1993, over 19% of British abandoned brownfield sites were transferred into green spaces, more than any other end-use. It is necessary to understand the real situation of the land, such as the land use history and contamination level. Meanwhile, the evaluation of the number and distribution of brownfields are important for the planning of land redevelopment and new housing planning at this scale. To classify land types, the definition of land use therefore became the priority of UK housing development. Urban geochemical mapping therefore commenced in 1992, responding to not only the evaluation on various contaminants in urban environments but the strategies in city planning, and viewed as requirements for brownfield redevelopment in the UK (Environmental Protection Act Part IIa1990). Currently, a common strategy is used for monitoring and redevelopment of brownfield in European countries (Burke et al., 2015), which is a risk-based management system and engages a wide range of stakeholders, including networks of regional and local authorities, civil society organizations, research institutes, industrial and professional associations.

2.4 Current decision-making process and management scheme for brownfield redevelopment

2.4.1 USA

To effectively manage brownfield, a National Priority List (NPL) was established by the US EPA to list those brownfields with potential significant risks to human health and environment. It is the main function in brownfield management to add brownfields into or remove them from NPL, associated with risk management and control process for brownfield redevelopment (Gaffney et al., 2005; NJDEP, 2007). The process for brownfield redevelopment is illustrated in Figure 2.4.

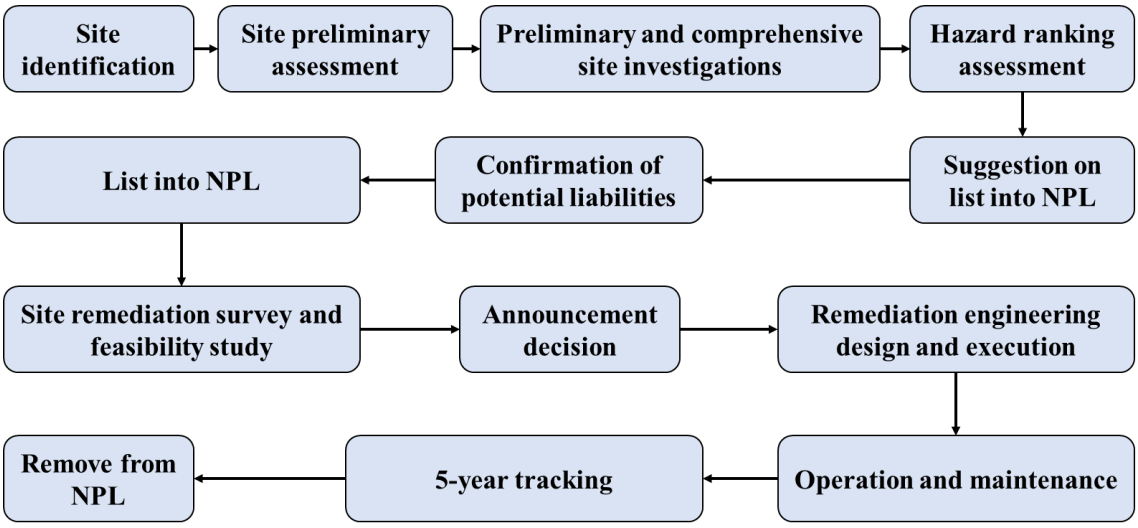


Figure 2.4 Brownfield redevelopment process in USA. The scheme is drawn based on (Gaffney et al., 2005; NJDEP, 2007).

Step 1: Site identification. Besides regular monitoring by the local EPA or reported by the public, the third way to identify potential brownfields is from the land owners or users, and all the three parties have the obligation to do so. Particularly, when the land is re-used, abandoned or transferred, the land users are asked to show the soil quality survey report. In this stage, besides the governmental duties, the awareness and involvement of the public and enterprises are encouraged.

Step 2: Preliminary and comprehensive site investigations. Preliminary and comprehensive site investigations are mainly aimed at identifying potential contaminants at the sites and evaluating whether clean-up actions should be taken. To avoid the omission of brownfields, this stage can be carried out several times.

Step 3: Hazard ranking assessment. The Hazard Ranking System (HRS) is the main approach to list the brownfield into the NPL, by assessing the potential risk of the site or brownfield to human health and the surrounding environment, with data obtained from site investigation. The HRS ranks the site by the structural analysis method, which assigns marks to all the factors related to risk, *e.g.*, the possibility of the site releasing hazardous materials, waste characteristics, communities or sensitive targets. Afterwards, a score is calculated by the exposure pathways to groundwater, surface water, soil and air, and then root squared to obtain the total mark (hazard ranking) of the site. For hazard ranking above 28.5, the site meets the criterion to be listed in NPL.

Step 4: List into NPL. Based on results from the site investigation and hazard ranking assessment, all the sites meeting the criterion from the three identification ways are listed on the NPL, requiring site remediation and long-term monitoring.

Step 5: Site remediation. After a site remediation survey, the contamination level, remediation standard, potential remediation strategies and remediation budget are evaluated for the preparation of a feasibility report. Subsequently, remediation engineering is designed, executed and maintained to ensure the progress of the remediation project.

Step 6: Remove from NPL. After the site is remediated and the remediation target achieved, long-term monitoring which normally lasts for 5 years is required and needs to be carried out to ensure the stability of remediation, before removal from the NPL. Through the whole process, parts of the contaminated area or specific contaminants can be removed from the NPL. After the remediation project, the site can be listed on the NPL again if any re-contamination is identified.

The Superfund Act authorizes the USEPA to manage nationwide contaminated sites. In each stage of Superfund site management, potential liabilities are notified for relevant management issues, and all the decisions and actions on brownfields and during remediation process will be released to the public (NJDEP, 2007).

2.4.2 United Kingdom

One of the main focuses for brownfield management and control in the UK is collecting land-use data, including the number, type and status of developed lands across the country. Currently, detailed information on nearly 66,000 hm^2 of developed land has been collected for database establishment. Based on the "redevelopment and utilization management model", the land database not only includes brownfield information, but focuses on the land development and utilization.The Ordnance Survey compiles the database, together with the Office of the Deputy Prime Minister, to publish the annual statistical report, updating and improving brownfield management process (Rudland and Jackson, 2004).

Step 1: Brownfield identification. Local government takes the major responsibilities for the identification of brownfield by inspecting and discovering detailed information of potential brownfield sites.

Step 2: Site investigation. The first proposed limit of soil pollutant concentration was

released in 1980 which requires site invesitgation and risk assessment for sites exceeding the limits.

Step 3: Risk assessment. In response to the requirement of risk assessment for brownfield redevelopment, the Environmental Agency began research on the technical framework for health risk assessment of brownfields in 1992 and published a series of reports in 2012 to provide an uniform approach for fast risk assessment and identification of brownfields. The regulation focuses on human health risks. In addition, Soil Guideline Values (SGV) for contaminant soil have been used as an important concept in the risk assessment process, which links pollutant concentration to its risks on human health and environment. The Contaminated Land Exposure Assessment Model (CLEA, 2002) is used as a general risk assessment guide, addressing the pollutants with a certain dose-effect relationship and exposure pathway under certain human activities and pollution characteristics.

Step 4: Remediation strategy consultancy. After determining the pollution level and risks at contaminated sites, the local government leads the consultation for the remediation strategies for brownfields.

Step 5: Announcement of requirements for brownfield remediation. The local government then issues formal announcements requiring polluters or land users to assume responsibility for brownfield remediation when necessary.

Step 6: Brownfield remediation. Brownfields are rehabilitated by the polluters or land users, and the remedation activities comply with the regulations of city planning department of local government, which supervises and manages the remediation activities and records relevant information. The local government should take action for brownfield remediation when no one else takes the responsibility.

Step 7: Brownfield supervision. The Ordnance Survey is responsible for the long-term supervision of brownfields and for updates regarding land-use change. Thisis done annually.

2.4.3 Other countries

Canada has issued a series of regulations to stipulate the specific processes for brownfield management, including *Ecological Risk Assessment Guidance*, *Human Health Risk Assessment For Federal Contaminated Sites In Canada Guidance*, *A Federal Approach to Contaminated Sites*, *National Classification System for Contaminated Sites (NCSCS) - Guidance Document (2008)*, *Federal Contaminated*

Sites Action Plan (FCSAP), *Environmental Quality Guidance Value*, *Health Risk Assessment Method of Contaminated Sites*, *Ecological Risk Assessment Framework: Technical Appendix*, *Contaminated Site Management Guidance*, *Risk Management Framework for Contaminated Site (Discussion Draft)*, *Soil Quality Guidance Value of Canada*, *Draft on Formulating Environmental and Health Soil Quality Guidance Values*, *Guide to Establishing Specific Soil Remediation Target Values for Contaminated Sites*, *Site Environmental Assessment Phase 1*, *Handbook for Surface Water Assessment of Contaminated Site*, *Sampling, Analysis, Data Management Manual for Contaminated Sites I: Main Reports*, *Sampling, Analysis, Data Management Manual for Contaminated Sites II: Analytical Methods*, *National Guide for Decommissioned Industrial Sites*, *Temporary Environmental Quality Standards for Contaminated Sites*. According to these regulations, a 10-step risk management control process for brownfield remediation has been established in Canada, including: 1) suspect brownfield identification, 2) historical review, 3) initial assessment, 4) brownfield clissification, 5) detailed assessment, 6) brownfield re-classification, 7) develop remediation and risk management strategy development, 8) brownfield remediation, 9) confirmatory sampling and final reporting, 10) long-term monitoring and supervision. The above 10-step management process is the standard management program for all brownfields; this is similar to that of the USA with minor modifications to meet the situation in Canada. Through these brownfield management policies, Canada has made detailed and feasible regulations on brownfield management which has been carried out in an orderly manner (New Brunswick Department of Environment and Local Government, Canada, 2003; Province of Newfound land and Labrador, Canada, 2004).

In other European countries, Rizzo's study indicates that the process of decision-making for the brownfield regeneration management contains five phases: planning and preparatory work; identification of stakeholder categories; engagement activities (focus groups and workshops); submission of a questionnaire and provision of feedback to the involved stakeholders (Rizzo et al., 2015).

2.5 Challenges for considering brownfield redevelopment in the decision-making process for city planning in China

The economic reform in China is a process promoting the dramatic growth of Chinese cities. It changes both the city development processes and the ways of city planning. However, urbanization and city planning have not occurred in concert. For instance,

city master plans are quickly outdated and unable to function effectively to guide city development (Wei, 2005). Thus, the decision-making process for city planning nowadays faces the challenges of quick decision-making, limited investment and increasing public awareness of sustainability (Leaf, 1998), in which brownfield redevelopment is a serious issue.

The current decision-making process for city planning in China does not consider brownfield redevelopment. City planning and brownfield redevelopment in China does not follow the same procedure as other countries. There are many critical issues requiring deeper discussion for the appropriate decision-making process for city planning, regarding the consideration of brownfield redevelopment. Firstly, the rapid urbanization and multi-level city planning scheme brings difficulties in appropriately considering brownfield re-development during the decision-making process within a short period or in a routine schedule. Secondly, there is a lack of well-established databases for brownfield sites and a lack of widely-accepted standards or regulations available for guiding brownfield redevelopment approaches. This brings troubles in setting appropriate remediation goals at brownfields when different remediation strategies are applicable to meet the requirement of future land use, challenging the determination of remediation budget during decision-making process for brownfield redevelopment and city planning. Finally, there is lack of a decision-making scheme for clear targets, standards and regulations to define the functions of the planned urban areas, with a consideration of the existing or potential brownfields, and brownfield redevelopers or others involved in the remedial management process have no strong power to make decisions during the city planning process.

2.5.1 Rapid urbanization shortens decision-making process for city planning

Despite the general picture presented in the previous section, since the 1990s, the clean-up and reuse of contaminated soils at brownfields is becoming more considered in city planning practices (Zhu et al., 2008). To efficiently and economically clean up the soils for new purposes, brownfield redevelopment can become part of the new urban land use strategy, to pursue sustainable development objectives.

As mentioned above, the urbanization rate in China is much faster than most parts of the world and this puts a much higher pressure on city planning. From the factors affecting brownfield redevelopment, rapid urbanization causes the changing of plan and

consequently resulting in the changing of land use. Engineers and architects were the main participants in the city planning process in the 1990s, so redevelopment plans generally concentrated on physical aspects. Although legislation on the prevention and control of brownfields has been introduced in 2014, it is probably too early to be able to see improvements in brownfield redevelopment. Accordingly, some Provisional Rules have been applied in different provincial and municipal areas.

2.5.2 Multi-level city planning challenges the routine scheme for considering brownfield redevelopment in city planning process

In China, the city planning process has its specific characteristics. Sjoberg has reviewed the central planning for urban areas in China, and identified key differences in city planning in the Chinese socialist society compared to capitalist ones (Sjoberg, 1999). First of all, China had central economic planning before 1979, and thus central city planning has dominated in Chinese urbanization for nearly 40 years. Secondly, the land resources ownership belongs to only the central or local government administration, which is responsible for land use allocation. Therefore, the State Council is the only central government authorizing decision-making for city planning. MLR manages the city planning process. Former MEP (now MEE) and their local bureau provide the data bases and help the MLR to deal with the city planning details.

The enactment of the 1989 City Planning Act was a major milestone, that tried to re-establish and formalize the city planning system in China (Yeh and Wu, 1999). Transformed from the central-planned economy to a transitional economy, the Chinese government established new housing and land markets, and more participants are therefore involved in the decision-making process for city planning.

Based on the types of urban projects and the owners of targeted sites, city planning in China can be categorized into three levels - the national level, the regional level, and the regional level with stated owned enterprises, as illustrated in Figure 2.5. This means there is different involvement of stakeholders and participation of related governments in the city planning process, respectively.

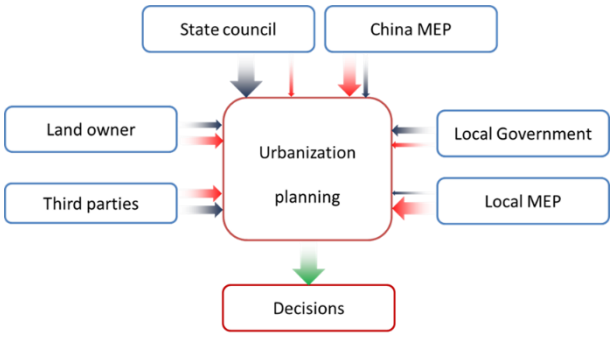
2.5.2.1 National city planning

National level city planning (Figure 2.5A) is mainly led by two central government authorities, the State Council and the MEE (MEP, 2015), which adapt suggestions from other relevant authorities e.g. local government, local MEP, third parties and land

owners. National city planning is usually a master plan for cities, with full consideration of city functions for national mega-projects, such as train networks, highway construction and functions under economic zone priorities. Different from other countries, China's MLR represents the State Council (who has the land resources ownership and is the subject of land use allocation) to manage soil resources and their functions include land planning, development, redevelopment, etc. Meanwhile, the MEE only provides land environmental monitoring/evaluation, if necessary or asked for, and makes suggestions to the MLR to improve city planning. The land owner, who has the rights of land use (not ownership of the land in the western capitalist sense), and local governments need to submit their regional planning as supplementary materials of the master plan to the MLR for approval, but their power and responsibility is limited. The local MEE is responsible to their central authority to ensure all the relevant information is reliable and viable, and the third parties are asked to associate in helping the local MEE complete the investigation. It can be concluded that the Chinese MLR holds the major role and responsibility during the decision-making process, while the local MEE provides essential data and also has a key responsibility.

2.5.2.2 Regional city planning

City planning at the regional level (Figure 2.5B) is normally regional planning and all the cities in China have this level 2 planning. The process of regional city planning is highly similar to that in the national master plan. The difference is that the local government, instead of the national MLR, represents the State Council on land use or city planning. The Provisional Rules provide a homogenous set of regional provisions in accordance with their reality. The local MLR designs and prepares the regional planning, whereas the central MLR takes the responsibility to review the regional city planning, evaluate any contradictions/conflicts and approves the plan. The Rules have been proclaimed by the local governments, who therefore are engaged in the activities with the local MEE such as: definition of contaminated sites, responsibilities for sites environmental management, monitoring function and applicable standards. The land owners help with supplementary materials, similar as under the national city planning. In this case, both the local and central MLR dominate in decision making.



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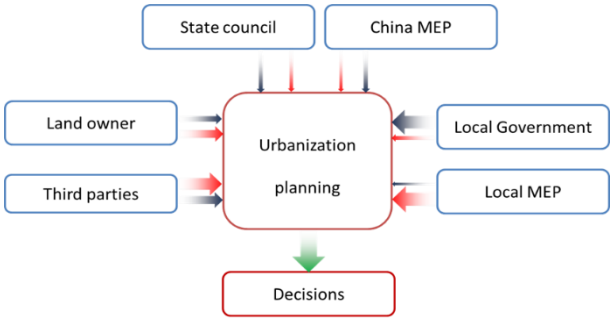

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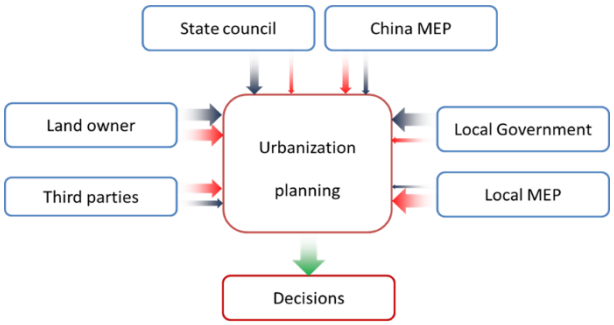


(C)

Figure 2.5 City planning at national level (A), regional level (B), and regional level participating with stated owned enterprise (C). Blue boxes represent key stakeholders in the decision-making process for city planning; red boxes represent the decision-making activities for city planning. Black arrows represent the current involvement of each stakeholder in the decision-making process for city planning; red arrows indicate ideal or suggested involvement of each stakeholder in the decision-making process for city planning. The level of involvement increases from narrow arrows (little) to wide arrows (more).

2.5.2.3 City planning with state-owned enterprise

Given the fact that China has the specific situation that the land is owned by stated-owned enterprise (*e.g.*, Baoshan Iron & Steel Co in Shanghai, China National Gold Group Corporation in Beijing), a third type of city planning needs to be taken into account at regional level but with special consideration of stated-owned enterprises (Figure 2.5C). The key feature in this mode is that neither local government nor state-owned enterprise can represent the State Council on land allocation. City planning associated with this type of land needs to be negotiated between the state-owned enterprise and the local MLR, followed by submission to the State Council for approval. Normally, the local MEE does not participate in the planning process, because it does not have open access to the land. Its main roles are to evaluate the site information, which is provided by the state-owned enterprises, and to assess the environmental risks.

2.5.3 Poor brownfield data availability restricts rapid evaluation and effective consideration of brownfield redevelopment during decision-making for city planning

A Chinese national survey identified 690 industrial sites from a total surface of 6,300,000 hectares; this included 81 abandoned industrial sites, 146 industrial parks, 188 solid waste processing venues, 13 oil producing districts, 70 mining areas, 55 sewage irrigation areas, and road-side soils of 267 major roads (Figure 2.6) (MLR, 2015). However, comparing to the UK which is a smaller country but has many thousands of brownfields, the numbers of brownfields in China might be underestimated and there is a lack of clear criteria to identify, select and investigate the potential brownfields. The main contaminant types detailed are heavy metal- and organic-contaminated brownfields (Teng et al., 2014).

The most important inorganic contamination in Chinese soils is usually considered to be heavy metals, including As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn (He et al., 2013). Addressing the urban soil quality in the 48 largest cities in China, some deeper information can be identified on heavy metal contamination (Wei and Yang, 2010). The mean concentration of Cr, Cu, Pb, Zn, Ni, and Cd in urban soils is 78, 115, 1350, 266, 99 and 1.6 mg/kg, respectively. All the details are listed in Table 2.1. Urban soils in all the cities have some areas exceeding values of Cd, Cu, Pb and Zn compared background values, but not necessarily exceeding the soil guideline values (SGVs).

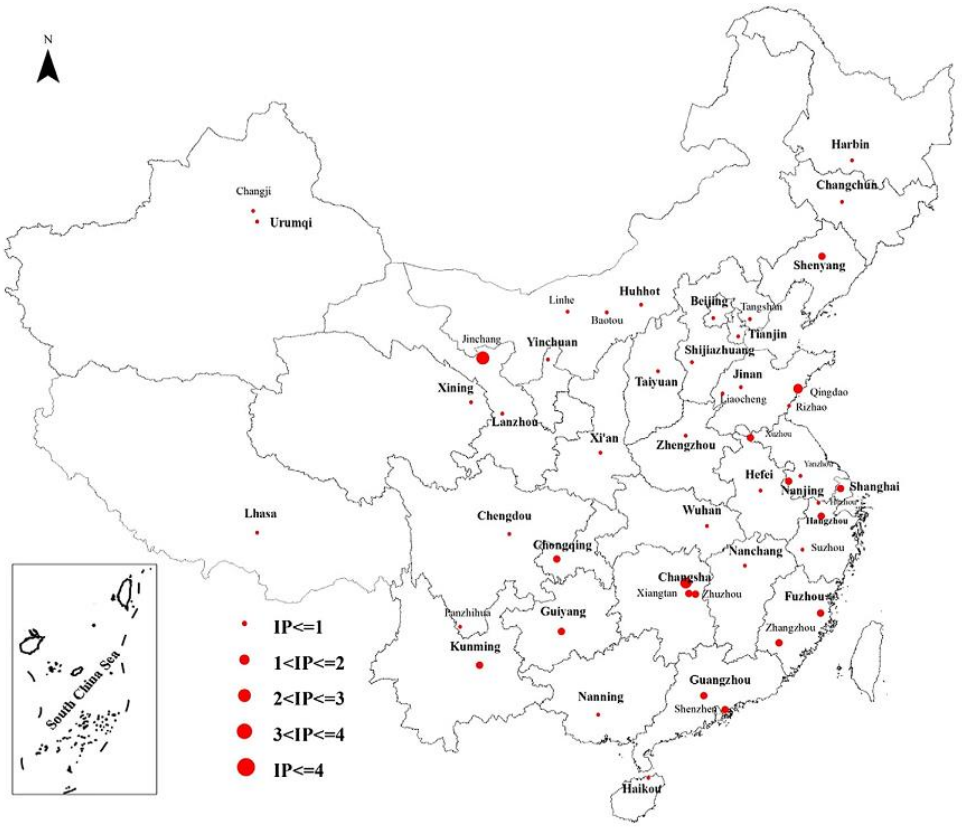


Figure 2.6 Heavy metal pollution in Chinese soils of 48 cities. Data are from Wei and Yang (2010) and He et al. (2013).

Chinese soil environmental quality is usually assessed by the soil pollution level (Table 2.1), e.g. evaluated by pollution index ($PI=1/n\Sigma(C_i/B_i)$, where n is the number of measured elements; C_i and B_i represent the element levels in targeted and background soils) based on total element concentrations. The heavy metal pollution levels vary among the 48 Chinese cities (Figure 2.). The soils are clean in 31 cities ($PI \leq 1$) and relatively clean in 11 cities ($1 < PI \leq 2.0$) (Xie and Li, 2010). The three cities with soil PI over 2.0 include Qingdao (2,68), Changsha (3.39) and Jinchang (9.99). Generally, the results indicated that the urban soils in Chinese cities are mainly "uncontaminated to moderately contaminated" by heavy metals, but in some specific areas, large areas of urban land can be defined as brownfield due to the soil quality being evaluated as "moderately to heavily contaminated" or "heavily contaminated" (Yang et al., 2016).

Given the fact that huge amounts of abandoned brownfields exist in Chinese megacities, like Shenyang and Guangzhou, the identification of site information is an important step in mapping brownfield distribution, evaluating site history, characterizing potential contaminants, and making sound and defendable decisions over brownfield

redevelopment (Cheng et al., 2011). Nevertheless, there is lack of sufficient historical data on brownfields to support decision making in city planning. For instance, of all the 370 brownfields in the Tiexi District of Shenyang city, only 71 sites have been investigated with some preliminary data on heavy metal contamination (Ren et al., 2014). The majority of brownfields are therefore still unknown. Such a lack of data on brownfields affects the evaluation of contamination level in those abandoned sites, and further influences the decision making of city planning (Ren et al., 2015).

2.5.4 Various remediation strategies challenge decision-making for brownfield redevelopment

In the early stages of brownfield work in China, brownfield remediation was normally aimed to maximize the removal efficiency of soil contaminants and minimize the health risks of soil contamination. With greater understanding of brownfield management and experiences in brownfield remediation, experts and government have realized that it is impossible or unnecessary, from both the technical and economic perspective, to remediate the brownfield as entirely clean land. For instance, USA and European countries in the 1960s set up the most restrictive remediation standards, which attempted (unsuccessfully) to clean the brownfield for any purpose or land use in the future. The high remediation costs and long remediation periods could not be approved or accepted by stakeholders or government, and such standards were therefore impossible to implement (Chen et al., 2019).

Remediation techniques are affected by both city planning and brownfield identification. By arguing over the remediation target, or so called "*how clean is clean enough?*", both economic and operational considerations are taken into account. Considering the set-up of land use or land functions for brownfield redevelopment, many experiences have been gained in western countries that city planning should be linked to brownfield redevelopment. During the city planning process, the land functions are planned. Thus, the adjustment and optimization of city planning will change the land functions and the remediation target, thereby optimizing the remediation budget and balancing the health risks and ecological functions. The aims of brownfield remediation then shift from mitigating the concentrations of contaminants in soils as the only target, to integrating environmental safety and economic effectiveness in redevelopment for proper functions.

2.5.5 Lack of strategic regulations for brownfield redevelopment

Brownfield redevelopment is a global challenge. From the long history of human activities, including industries, construction, and transportation, many brownfields can be identified in urban areas. They not only provide a potential threat to human health and the natural environment, but also influence the development or redevelopment of land resources, further affecting city planning, estates transaction, and urban environment management (Liu et al., 2014b). Many European countries and the USA have already applied legislative management for brownfield redevelopment, which promotes site investigation, evaluation and remediation technologies, helping in the standardization, systematization and standardization of brownfield management. Currently, there are a number of relatively complete regulations, policies, technologies and international standards for brownfield redevelopment, which provide good experience and technical reference for brownfield management and governance for developing countries, including China (Cao and Guan, 2007).

As a rapidly developing country, China faces severe challenges of industrialization, agricultural intensification and urbanization. All these activities cause environmental contamination and contaminated sites (Chen et al., 2009). The main industrial activities include mining, chemical manufacturing, metal manufacturing, petroleum, coking, paper, electronics, energy and electricity supply, waste disposal, resource recycling industry, etc. Chinese brownfields can therefore have the following features: various contamination types, large area and heavy contamination. It has become one of the major challenges to be solved in urban environmental management and land use safety.

As noted earlier, in recent years, the Chinese government has paid more attention to brownfield, and set up a series of notifications, requirements and guidance documents to improve brownfield management and redevelopment. Chinese former MEP (now MEE) has released the *Term in Contaminated Land*, *Technical Guidelines for Site Environmental Investigation*, and *Technical Guidance for Contaminated Sites Risk Assessment* in 2012. The 2016 Soil-Ten Plan is the final component of China's pollution plan trifecta, highlighting the three-year schemes of large-scale brownfield monitoring, brownfield laws and regulations, and large-scale brownfield redevelopment pilots. Released by the Chinese MEE and the MLR, the Soil-Ten Plan hints that China has taken brownfield redevelopment into the strategic city planning process. Nevertheless, China still has limited experience in risk management and redevelopment of

brownfields. Until now, only a small proportion of China's brownfield land has been identified and monitored, and there are limited cases of successful brownfield redevelopment.

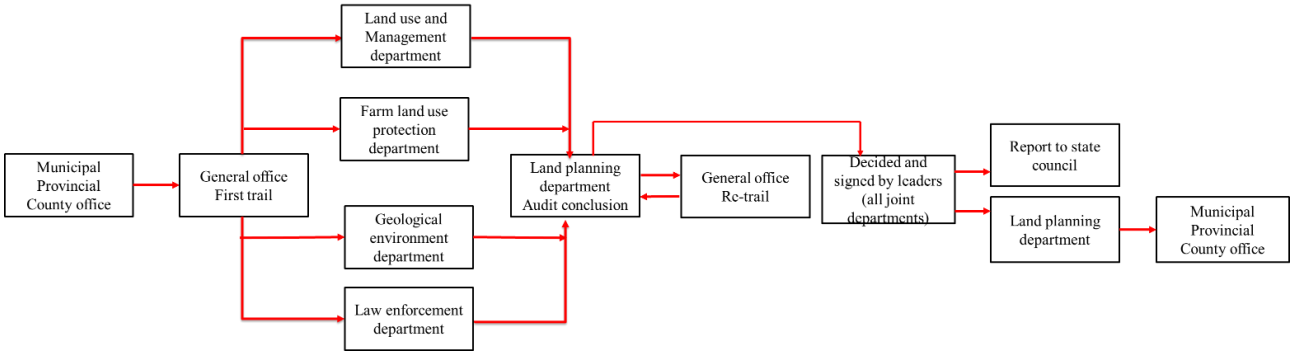
Currently, there are general and routine processes of land development and brownfield redevelopment in China, as illustrated in Figure 2.7. In land development, the Chinese MLR takes the responsibility for all the activities listed in this process (Figure 2.7A). The general office of the local government (municipal/provincial/county) submits their development plan/proposal to the general office of the local MLR or the national MLR at the first step. From further analysis in the government structure, six departments in the national MLR are engaged. The functional departments include the General Office (thirty-eight officers), the Land Use and Management Department (eighteen officers), the Farmland Use Protection Department (twenty officers), the Geological Environment Department (eighteen officers), the Law Enforcement Department (twenty-two officers) and the Land Planning Department (nineteen officers). The general office will process the first case and modify the plan/proposal, followed by allocation to other relevant departments with respective functions. The four key relevant departments in the MLR are the Land Use and Management Department, the Farmland Use Protection Department, the Geological Environment Department and the Law Enforcement Department. After the second-round review and modification, a new version of the plan/proposal will be submitted to the Land Planning Department for deliberation, summary and approval. If not approved, the plan/proposal will be rejected and sent back to local government. If approved, the general office will process the re-submission with the Land Planning Department, to discuss and get final agreement on the development plan. After signing the documents by the representatives from all the responsible departments at the third stage, the plan/proposal will be finally re-posted to the State Council and collected for recoding. Meanwhile, the Land Planning Department will return this final version to the local government and supervise them to process the development or redevelopment process. It is obvious that the MEE is therefore not directly involved in the current land development process. Although some similar departments exist in the MEE, they do not have the power in the decision-making process.

For the brownfield redevelopment, a different decision-making process is used (Figure 2.7B). Besides six departments in MLR, some in the MEE are also engaged. The eight

out of sixteen departments in the MEE involved in the process are the Department of Planning and Finance, Department of Policies, Law and Regulations, Department of Science, Technology and Standards, Department of Environmental Impact Assessment, Department of Environmental Monitoring, Department of Pollution Prevention and Control, and Department of Nature and Ecology Conservation. However, the MEE is not involved in the first steps of city planning. They take part in the second-round review and modification, where the MEE expresses their concerns about monitoring and remediation issues in the targeted brownfield. After both the MEE and the MLR revise the plan or proposal, the new version of the plan/proposal will be submitted to the Land Planning Department, following the same procedure as described above in the land development process. However, here although the MEE is directly involved in the brownfield redevelopment, they do not participate in the first stage and the situation of brownfields is not the priority in the redevelopment plan. It therefore causes many negative consequences and complicated revisions in the brownfield redevelopment plan or proposal, and even leads to misinformation on the land use.

The slight difference between the development and redevelopment process is that the Land Use and Management Department has the responsibility to take the following five extra activities, as shown in Figure 2.8. Land purchasing is the first stage to levy property and arrange population migration. Land consolidation involves demolition of properties and land levelling is in the second phase. Subsequently, land reservation and land bidding represent the preparation and completion of land transfer, respectively. Finally, the new landowner will prepare the land redevelopment plan/proposal, which is merged with the general process of land development.

It can be envisaged that a proper strategy for the involvement of a considerable number of stakeholders with potentially divergent interests could be a key to successfully overcoming existing shortcomings. For instance, stakeholders are considered as any organization, group or person who takes an interest in a project, or those who have the ability to influence its outcomes. Experts and decision makers are therefore regarded as the key stakeholders in terms of their perceived critical role in initiating and guiding the redevelopment process (Cundy et al., 2013). Such involvement of stakeholders should be taken in all phases of the urbanization process and brownfield management as an important prerequisite to improve decision-making, but is neglected in China.



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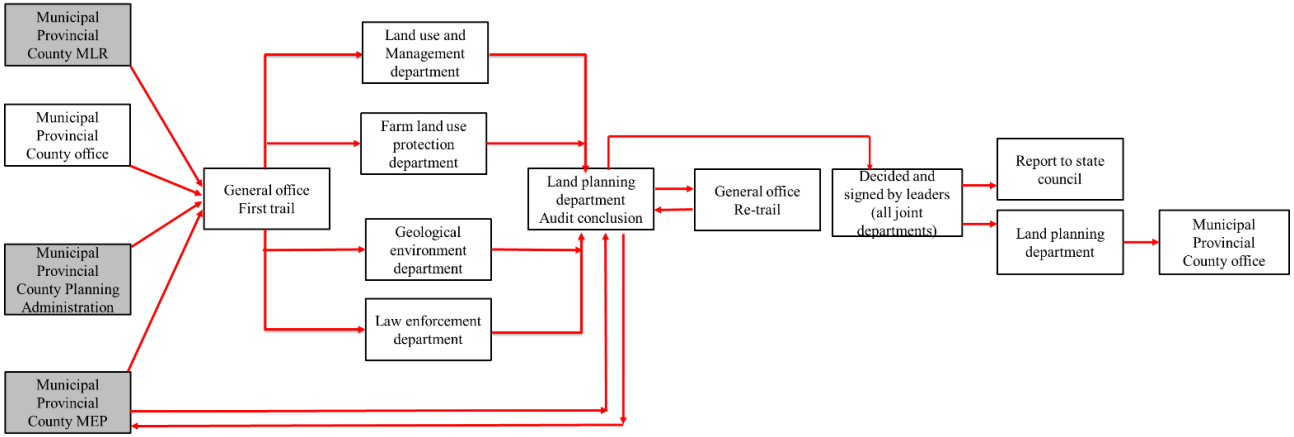

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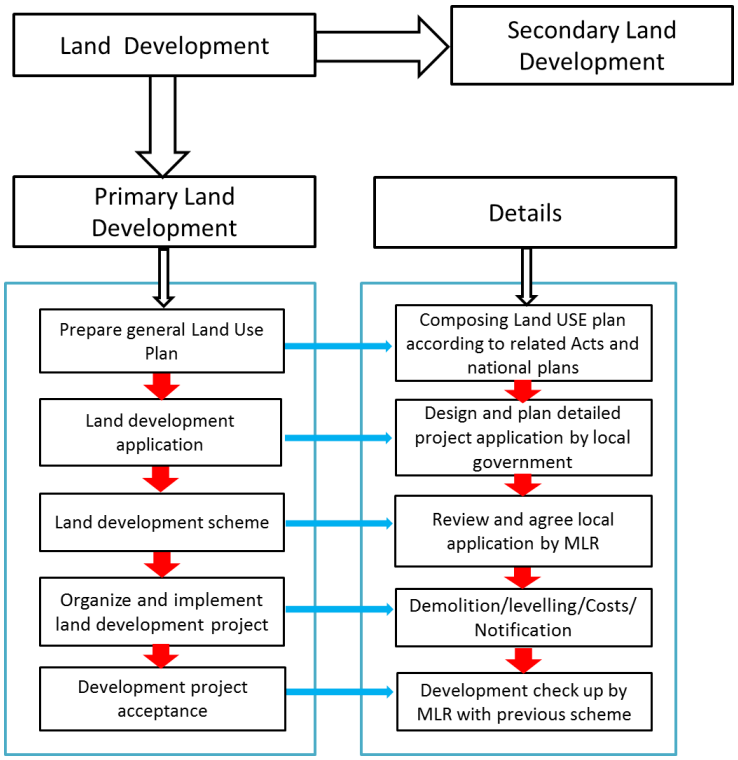
Figure 2.7 General process of land development (A) and brownfield redevelopment (B) in China. Schemes are drawn based on the guidelines and regulations in MLR.



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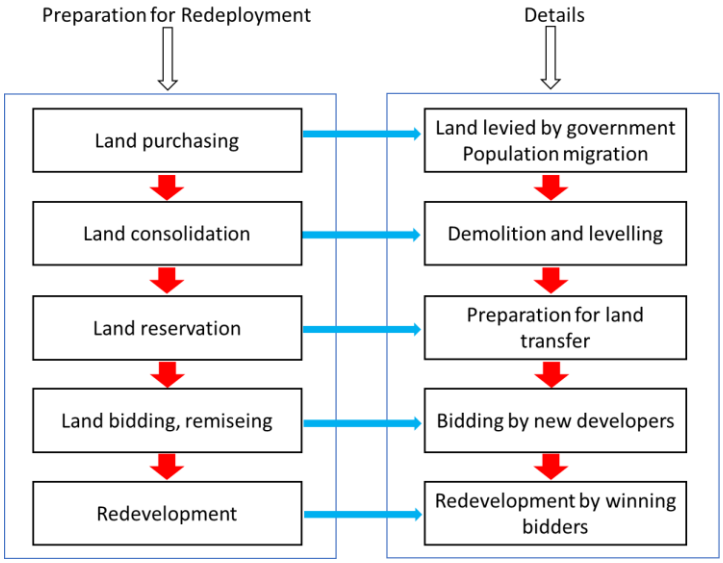


(B)

Figure 2.8 Extra activities in Land Use and Management Department for land development (A) and brownfield redevelopment (B) in China. Schemes and relationships are drawn based on the guidelines and regulations in MLR. Black boxes represent key steps and relevant activities for land development and brownfield redevelopment. Blue arrows indicate sequential progress; blue arrows link key steps and relevant activities.

2.5.6 Minimal power of brownfield redevelopers in decision-making for city planning

When brownfield sites are identified, it has been suggested that policy interventions should consider functional zones when planning land use at the redeveloped contaminated site. Ideally the decision should be made in cooperation with both city planners and brownfield redevelopers, as the experts of brownfield redevelopment should understand the risks of target sites and offer suggestions on the most suitable or appropriate land functions in future. In addition, the remediation targets of brownfields are determined by land future functions, and brownfield redevelopers can evaluate the remediation budget after the land functions are planned and the remediation strategies are assessed afterwards. Accordingly, brownfield redevelopers' evaluation of the remediation budget can help in decision-making to set up the achievable functions for land future use. However, during the current decision-making process for city planning, the involvement of brownfield redevelopers is limited and there is no part of the regulatory process ensuring the right of brownfield redevelopers to examine or verify the city planning. Thus, brownfield redevelopers have minimal power in the decision-making process or to provide useful suggestions to optimize city planning regarding brownfield issues.

2.6 Research hypotheses and proposed project objectives/directions

From reviewing the literatures above, it is proposed that an integrated model is urgently needed to promote collaborative decision-making in these large-scale processes of brownfield redevelopment during the city planning process.

2.6.1 Integral decision-making process in city planning to effectively consider brownfield redevelopment

Rapid urbanization and the multi-level city planning process raises the challenges that there is limited time and efficiency in the decision-making process for city planning, which therefore lowers the opportunity for consideration of brownfield redevelopment. The requirements for considering brownfield sites in the Chinese system is relatively new, so the system needs to be adapted to take account of this. Collaborative activities in which data and models are shared by participants from different stakeholder groups can be found in many city planning models internationally (Baloian et al., 2015). Decision-makers who are experts with various backgrounds and knowledge contribute with their viewpoints, and final solutions should consider all the viewpoints raised by

different experts to get their agreement. Although literature and cases can be found which discuss the procedures and practices for combining contradictory opinions from different decision makers, there is no well-accepted system explicitly achieving final joint agreement, particularly for considering brownfield redevelopment in city planning.

2.6.2 Appropriate participants with strong power in the city planning process to consider brownfield redevelopment

In normal city planning cases at the national level, one or two officers from each department will group and make group-oriented decisions. It is suggested to access at least two participants from each department (totally around 30 participants). Similar number of participants from local government (including local MEE) will also be surveyed. For other authorities, the expected number of participants will vary in accordance with their power and contribution in decision making for city planning and brownfield management.

2.6.3 Practical actions for effective consideration of brownfield redevelopment in the decision-making process for city planning

It is proposed that brownfield management needs to be considered as one of the key components in Chinese urbanization. The problems in data availability need to be addressed by the Chinese MEE for future national surveys to target the detailed information about brownfields. The characteristics of brownfields, including contamination history, current contamination types and levels, stakeholders, etc., are required for a national brownfield database as essential materials for city planning. It is also proposed that the MEE should have more participation and power in decision-making for city planning. From the current involvement in evaluation of city plan proposal and subsequent risk assessment on brownfield, the roles of MEE should be engaged more into the design and preparation urban proposal together with China MLR. Thirdly, public participation will be a valuable component in decision making process in brownfield redevelopment. All the stakeholders should be involved in the whole procedure of brownfield redevelopment.

2.7 Research aims and objectives

2.7.1 Aims

The general purpose of this project is to improve knowledge and understanding of how

decisions are made regarding the assessment and redevelopment of brownfield land within Chinese city planning processes.

Some specific objectives, arising from the review above, include:

[1] To understand why and how brownfield redevelopment is considered within the city planning process

[2] To understand the roles of different stakeholders in city planning and brownfield redevelopment, and how they are involved in the decision-making process

[3] To understand the decision-making process for city planning in China and how brownfield redevelopment is currently considered in that process

[4] To see how brownfield redevelopment is currently actually being addressed 'on the ground' in some Chinese cities

[5] To understand how the process operates in the UK, a country with a more established brownfield redevelopment framework, and to consider whether there may be useful lessons to learn that are transferrable to the Chinese decision-making approach

To address these research objectives requires an information gathering exercise, consulting with practitioners and experts who are directly involved in China. That is the purpose of the questionnaire and interviews conducted in this thesis.

Certain topics required focus. Namely:

- To identify the relationship and contradictions between city planning and brownfield redevelopment
- To understand the changing situation and process of decision making in city planning, regarding to the dynamic and changing policies and regimes in China
- To identify the actions of decision-making for city planning related to brownfield redevelopment and management and how they affect brownfield redevelopment process.

This is followed by a detailed evaluation of the information obtained, so that - with the benefit of the knowledge and experience gained - suggestions can be made as to how the decision-making processes for city planning in China may be improved, in order to

better manage brownfield land during its redevelopment.

Below, these aims are developed into a series of precise and concise objectives.

2.7.2 Objectives

[1] To understand the current and changing decision-making process during city planning in China.

[2] To understand the extent and how brownfield redevelopment is considered in the decision-making process for city planning.

[3] To identify different decision-making processes for city planning in different cities.

[4] To compare brownfield management strategies between Chinese and western cities.

[5] To develop and suggest novel systematic scheme(s) for industrial brownfield redevelopment pertaining to the decision-making process for city planning.

3. Research methods

3.1 Research philosophy

3.1.1 Introduction to the challenge and approach

To establish the roles of key stakeholders (city planners, brownfield redevelopers and members from third parties) in the brownfield redevelopment process, opinions from different stakeholders need to be collected and comprehensively analyzed. The objectives were to understand and to distinguish the current roles, views and involvements of stakeholders, to seek their knowledge and views on the current decision-making process, and to seek their view on improvements which could be made to the decision-making process for city planning and brownfield redevelopment.

As discussed in Chapter 2, brownfield redevelopment now should be considered in China's city planning process under the guidelines and regulations related to land use and city planning. However, it is unclear whether brownfield redevelopment is actually and routinely considered effectively in practice. No previous work appears to have conducted on this topic. It was therefore decided to gather data from practitioners, experts and stakeholders. It was decided that data gathering should take two forms – a questionnaire and a face-to-face interview.

3.1.2 Features of questionnaires

A questionnaire can be designed to obtain qualitative and quantitative information in a survey. The information gathered from cohorts of participants can be evaluated statistically, with the use of appropriate techniques. The questionnaire can contain fixed questions and options for participants to choose. It can be designed to ask participants to select from defined answers/options, or to complete textual feedback. With the former approach, the answers are in the same format for further statistical analysis. Compared to other survey approaches, a questionnaire generally takes less time to complete and it is generally easy to get the consent of participants. A large number of participants can therefore generally be accessed. However, the results rely on careful selection of participants, well-conceived questions and instructions; more participants can lead to more reliable findings. As all the questions are set in advance, it needs comprehensive analysis of the research aims and objectives to design the questionnaire appropriately. If the questionnaire is the only method of data gathering, it is not possible to have deeper communication with participants, to extract valuable information not covered by the

questions, or to follow up ambiguous or unclear answers.

3.1.3 Features of interviews

Different from questionnaires, interviews can use open questions for deeper discussion with participants. Based on the answers and responses from participants, directed questions can be freely raised for comprehensive communication with participants, to get more in-depth information. However, interviews are relatively time consuming and often only a limited number of participants are willing to take part in interviews. Since questions are different across participants, statistical analysis cannot be used for interview and comprehensive data analysis requires longer time. Two additional challenges are: firstly, if the topics to be discussed are sensitive or controversial, participants may be reluctant to answer fully and/or honestly, even if anonymity is promised as a condition of the interview. Secondly, the interviewee needs to be fully aware of the materials to be discussed at interview, to be able to ask follow-up questions/questions of clarity, and the interviewee needs to be able to manage the time for discussion and direction effectively.

3.1.4 Combination of questionnaire and interview

Given the advantages and potential disadvantages of either questionnaires or interviews, and the research problems to be investigated in this project, it was decided to use both a questionnaire and interviews to gather information. The questionnaire was designed to collect basic information, to obtain a brief view of the research topics, to fill in the knowledge gap about the current situation of city planning and brownfield redevelopment in China and to help with easier access to participants. Subsequently, some of the participants were willing to take part in a face-to-face discussion around open interview questions about the details of decision-making, driving forces and influential factors related to city planning and brownfield redevelopment.

3.2 Research hypothesis

Regarding the research questions listed in Chapter 2, three hypotheses were raised to address the knowledge gap and design the detailed questionnaire and interview.

The first hypothesis, arising from the literature review, is that brownfield redevelopment is tightly linked to land use planning and therefore potentially associated with city planning:

***H1*: There is strong correlation between city planning and brownfield redevelopment. Considering brownfield redevelopment in decision-making for city planning can benefit both city planning and brownfield redevelopment.**

***H0*: There is no significant correlation between city planning and brownfield redevelopment. Considering brownfield redevelopment in decision-making for city planning is not necessary or will not significantly benefit both city planning and brownfield redevelopment.**

Testing this hypothesis will contribute to our understanding on why to consider brownfield redevelopment in the decision-making process for city planning and achieve research objective (1) "to understand the current and changing decision-making process during city planning in China".

The second hypothesis considers the current situation of city planning in China, owing to the fact that a lack of brownfield databases and regulations results in limited consideration of brownfield redevelopment during decision-making for city planning.

***H2*: Decision-making for city planning in China does not fully consider brownfield redevelopment, which restricts appropriate brownfield management.**

***H0*: Decision-making for city planning in China fully considers brownfield redevelopment and does not hamper appropriate brownfield management.**

This hypothesis is linked to research objective (2) "to understand the extent and how brownfield redevelopment is considered in the decision-making process for city planning" and objective (3) "to identify different decision-making processes for city planning in different cities". By testing this hypothesis, the influential or restriction factors for the consideration of brownfield redevelopment in the decision-making process for city planning can be clearly recognized and comprehensively discussed for further improvement.

The third hypothesis is based on the improvement of brownfield redevelopment through properly considering brownfield redevelopment during decision-making for city planning.

***H3*: There are some key influential factors restricting the consideration of brownfield redevelopment during decision-making for city planning. Further implementation should address these influential factors to solve the problem.**

***H0*: There are no key influential factors restricting the consideration of brownfield redevelopment during decision-making for city planning.**

This project aims to test this hypothesis and focus on research objective (4) "to compare

brownfield management strategies between Chinese and western cities" and objective (5) "to develop and suggest novel systematic scheme(s) for industrial brownfield redevelopment pertaining to the decision-making process for city planning", attempting to set up theoretical framework and offer practical actions to implement brownfield redevelopment in China.

3.3 Selection of participants

3.3.1 Main stakeholders and their roles in city planning and brownfield redevelopment

Many stakeholders participate in the decision-making process of city planning and brownfield redevelopment. They include government officials, city planners, officers in the MEE, officers in the Land Use Department, managers for city planning, managers for brownfield assessment, managers for brownfield redevelopment construction, current land users, and future land users, as listed in Table 3.1. As there are many categories and levels/areas of responsibility, and their roles are different, it is important to evaluate their importance, accessibility and link to the research aims, and then select appropriate participants in this survey.

3.3.2 Evaluation of the accessibility and link of stakeholder groups to the research aims

After careful evaluation from the literature, a knowledge of the decision-making processes (see Chapter 2) and preliminary communication, three groups of participants were identified as being difficult to access - namely government officials, current land users and future land users (Table 3.1).

To evaluate the candidate participants from different stakeholder groups, two criteria were considered, namely links to the research aims and accessibility, based on critical analysis of the questionnaire survey and discussion with academic experts to assess their validity. "Accessibility", was defined by whether the interviewees would agree to take the survey and to participate fully and openly. If most of the participants did not want to take the survey, they are given one star, whereas when all participants have no hesitation or co-operate with the survey, they are given three stars.

Senior government officials are important as the key decision-makers for city planning, but their positions are also sensitive. Although they know well the details of decision-making for city planning and are clear about the driving forces and problems - and may have suggestions to improve brownfield redevelopment through the city planning

process - they may not be willing to answer most of the questions or only answer some simple questions with limited depth. Accordingly, their accessibility was marked as one star in Table 3.1.

Additionally, current and future land users are also hard to access for the state ownership of land. They do not directly have the ownership of land and can be only involved in the step of land development, not in the decision-making process for city planning or brownfield redevelopment. They are not familiar with either city planning or brownfield redevelopment, and are often not willing to participate in the survey. They are therefore also given one star for their accessibility.

In summary, Table 3.1 provides a semi-quantitative and necessarily rather subjective assessment or screening of various stakeholder groups. Those with at least five stars from link to research aims and accessibility were preferred as participants for this research.

Table 3.1. The accessibility and link to research aims of different participants.

Question	**Link to research aims**	**Accessibility**
Senior government officials	★★★	★
City planners	★★★	★★
Officers in the Land Use Department of local Land Resource Agency	★★	★★
Officers in the Environmental Protection Agency	★★★	★★★
Officers for city planning	★★★	★★★
Officers for brownfield assessment	★★★	★★★
Officers for brownfield redevelopment construction	★★★	★★
Current land users	★★★	★
Future land users	★★★	★

★★★: Strong link or easy accessibility. ★★: Moderate link or accessibility. ★: Weak link or hard accessibility.

3.3.3 Key participants

Based on the roles and accessibility of each of the groups, all the stakeholders related to city planning and brownfield redevelopment are categorized into three main groups:

city planners (city planners, officers in Land Use Department, officers for city planning); brownfield redevelopers (officers for brownfield redevelopment construction); and members from third parties (officers in Environmental Protection Agency, officers for brownfield assessment). They were selected as participants for the survey.

3.4 Selection of study cities

3.4.1 Criteria

Considering background information of Chinese cities, some criteria were evaluated for the process to select cities for survey. These included: city population, industrial history, location and culture, and politics.

3.4.2 Population

Population indicates the urbanization level and economic development of a city. Higher population hints at higher urbanization level and larger city area, whilst indicating greater importance and potentially more brownfields to be investigated. From statistical data, China has five cities with a population above 10 million, namely Shanghai, Beijing, Shenzhen, Guangzhou and Chongqing. There are eight cities with populations above 5 million, namely Tianjin, Wuhan, Chengdu, Dongguan, Nanjing, Zhengzhou, Hangzhou and Shenyang.

3.4.3 Industrial history

Longer industrial history indicates potentially heavier soil contamination and more brownfields; potentially greater awareness of brownfield sites and redevelopment issues. Of the thirteen cities with populations above 5 million, Shanghai, Beijing, Guangzhou, Wuhan and Shenyang have longer industrial histories - since the early 1900s (over 100 years) and hence are important to represent in the cities to be studied.

3.4.4 Location and culture

The huge area of China leads to a highly diverse culture across the country, mainly categorized by their locations. Northern China, Eastern China, Mid-Western China and Southern China have unique cultures, with potentially different opinions towards city planning and brownfield redevelopment. Of the five cities mentioned above, Beijing and Shenyang are representatives of Northern Chinese culture and Shanghai represents Eastern Chinese culture, and Wuhan and Guangzhou from their locations belong to

Middle-Western China and Southern Chinese culture, respectively.

3.4.5 Politics

Although Beijing and Shanghai are good candidate cities for this survey, they are sensitive from political aspects as the capital and largest city in China, respectively. Most of the city planners and brownfield redevelopers have close relationships with other governors at the national level. Hence, they are not so easy to access or – it was concluded - may be conflicted by taking the survey. Accordingly, city planners and brownfield redevelopers in these two cities were found to be of limited accessibility.
In summary, from all the criteria considered above, Shenyang, Wuhan and Guangzhou were selected as the target city in this project.

3.5 Pilot survey

As there has been no previous study targeting the relationship between city planning and brownfield redevelopment, it was hard to initially design proper questions for the questionnaire and interview, and to have any sense of the willingness of participants to be involved. It was therefore decided that it was important to design a preliminary or 'pilot' questionnaire and interview list and to test them in a pilot survey, before the formal survey, to test whether the designed questions were likely to be suitable for this work, and to evaluate the approaches likely to be successful in ensuring access to the participants.

3.5.1 Design of the pilot questionnaire

The questionnaire for the pilot survey was designed in two parts. Part 1 included 8 questions on the background (age, institute, government, department, position, etc.) and roles of participants in city planning or brownfield redevelopment. Part 2 had 12 questions on the practical decision process for city planning and brownfield redevelopment, as listed in Table 3.2.

Table 3.2 Pilot questionnaire sheet.

Interviewer background

1. Which city are you in?
   A: Wuhan B: Guangzhou C: Shenyang
2. Which stakeholders group are you in?
   A: Local government related to urban planning
   B: Agencies for urban planning
   C: Local environmental agency
   E: Brownfield redeveloper
   D: Land user
   F: Others _____
3. How long have you been in this stakeholder group?
   A: less than one year
   B: one to three years
   C: three to five years
   D: more than five years
   E: Others _____
4. What is your current position?
   A: Director of department
   B: Manager for urban planning or brownfield redevelopment project
   C: Other staffs in government or agencies
   E: Others _____

Questions for urban planner

5. Which of the following factors are the main driven forces affecting decision making in city planning?
   A. Central government or national plan.
   B. Local economic development.
   C. Local sustainable development.
   D. Others. _____
6. How do these driven forces affect the land planning and use (1 for least and 5 for most important)?

	1	2	3	4	5
Central government or national plan					
Local economic development					
Local sustainable development					
Others					

7. How do these driven forces affect decision making in city planning? (1 for least and 5 for most important)?

	1	2	3	4	5
Central government or national plan					
Local economic development					
Local sustainable development					
Others					

8. Which driven forces will affect your decision most within your responsibilities? (1 for least and 5 for most important)?

	1	2	3	4	5
Central government or national plan					
Local economic development					
Local sustainable development					
Others					

9. How do these driven forces affect the brownfield redevelopment? (1 for least important and 5 for most important)?

	1	2	3	4	5
Central government or national plan					
Local economic development					

Local sustainable development					
Others					

10. Are you aware of the following issues?

	Completely unclear	Limited	To some extent	Completely Clear
Current situation of land use				
Contamination level of land use				
Number and location of brownfield				
Contamination level of brownfield				

11. How are the involvement of brownfield redeveloper and third party in decision making for city planning? (1 for least involvement and 5 for most involvement)?

	1	2	3	4	5
Brownfield redeveloper					
Third party					

12. How do you think city planning can affect brownfield redevelopment strategies? (1 for least important and 5 for most important)?

	1	2	3	4	5
Roles in decision making					
Setting future land use and function					
Setting redevelopment target					
Setting redevelopment budget					

Questions for brownfield redeveloper

13. Which of the following factors affect brownfield redevelopment the most?
    A. City plan.
    B. Future land use and target.
    C. Redevelopment cost.
    D. Redevelopment strategies.
    E. Others. _____
14. How do these factors affect brownfield redevelopment (1 for least important and 5 for most important)?

	1	2	3	4	5
City plan					
Future land use and target					
Redevelopment cost					
Redevelopment strategies					
Others					

15. How are the following issues related to city planning? (1 for least and 5 for most close)?

	1	2	3	4	5
Future land use and target					
Redevelopment cost					
Redevelopment strategies					
Others					

16. Are you aware of the following issues?

	Completely unclear	Limited	To some extent	Completely Clear
Current situation of land use				
Contamination level of land use				
Number and location of brownfield				

Contamination level of brownfield				

17. How do you think city planning can affect brownfield redevelopment strategies? (1 for least important and 5 for most important)?

	1	2	3	4	5
Roles in decision making					
Setting future land use and function					
Setting redevelopment target					
Setting redevelopment budget					

18. How are the involvement of city planner and third party in brownfield redevelopment process? (1 for least involvement and 5 for most involvement)?

	1	2	3	4	5
City planner					
Third party					

Questions for third party

19. Are you aware of the following issues?

	Completely unclear	Limited	To some extent	Completely Clear
Current situation of land use				
Contamination level of land use				
Number and location of brownfield				
Contamination level of brownfield				

20. Are you clear about the decision making for city planning or brownfield redevelopment?

	Completely unclear	Limited	To some extent	Completely Clear
City planning				
Brownfield redevelopment				

21. Have you been involved in the decision-making process for city planning brownfield redevelopment as advisor? (1 for least involvement and 5 for most involvement)?

	1	2	3	4	5
City planning					
Brownfield redevelopment					

22. How do you think city planning can affect brownfield redevelopment strategies? (1 for least important and 5 for most important)?

	1	2	3	4	5
Roles in decision making					
Setting future land use and function					
Setting redevelopment target					
Setting redevelopment budget					

3.5.2 Design of the pilot interview

Pilot qualitative interviews were also prepared, to help qualify the questions for the later full/formal interview process. The interview questions were prepared in three parts, and each of them addressed one group of participants (city planners, brownfield redevelopers and members from third parties). For each part, ten key questions were prepared. Questions 1-3 were intended to gather information about the key driving forces affecting decision-making for city planning and Questions 4-6 focused on the detailed driving forces and how they affect decision-making for city planning and brownfield redevelopment. Questions 7-10 used scenarios to discuss with participants their different involvement or roles in decision-making for city planning pertaining brownfield redevelopment. The overall interview aimed to obtain further information and practical details about decision-making for city planning, as well as whether or how brownfield redevelopment is considered in city planning.

Table 3.3 Question lists for pilot interview

General interview questions for all participants:

1. Personal background

Which department are you in?

What is your roles in city planning or brownfield redevelopment

Interview questions regarding research questions

1. What is the decision-making process for city planning in China?

For city planner

1.1. What is the current decision-making process for city planning in China?

1.1.1. How many key steps are involved?

1.1.2. Who are the important decision maker during this process?

1.2. Do you think the current decision-making process for city planning effective?

1.2.1. If yes, why do you think it is effective? Which step is the most effective one? Can you give an example to show how effective it is?

1.2.2. If not, why? Which step is the least effective one? Can you give an example to show the reason causing the less effectiveness?

1.3. Do you think the practical decision-making process for city planning is the same as national guideline?

1.3.1. If yes, do you think it is effective enough regarding local situation? Do you want to make some change in decision-making process to improve its effectiveness?

1.3.2. If not, what is the main difference? What is the main reason causing such difference? Of central plan, local economic development and sustainable development, which one can cause the difference the most?

1.3.3. Does the city planning follow "National Urban and Rural Planning" Art?

1.3.4. Is the city planning "consistent with land use planning" and "comply with the corresponding environmental laws and regulations"?

1.3.5. Is the city plan "released to the public and expert seeking for their advice"?

1.4. Which factor do you think affect the practical decision-making process for city planning the most?

1.4.1. Could you please explain how it affects with some examples? Please explain some more details about its influence on the overall and part of decision-making process for city planning.

1.5. Do you take the advices from other stakeholders for city planning?

1.5.1. If yes, whose advice will you take? In which step should it be considered?

1.5.2. If no, why?

1.5.3. Do you think advice affect the decision-making process?

1.5.4. If yes, how? If not, why?

1.5.5. Do you think the advices need to be considered during the decision-making process? Why and how?

For brownfield redeveloper

1.6. Are you aware of the decision-making process for city planning?

1.6.1. If yes, could please explain the practical decision-making process in your city?

1.6.2. If not, why?

1.7. Are you involved in the decision-making process for city planning?

1.7.1. If yes, in which step are you involved? Does your involvement really contribute to the decision-making process, or just a token?

1.7.2. If not, why?

1.8. Do you think you should be involved in decision-making process for city planning?

1.8.1. If yes, in which step should you be involved and why?

1.8.2. If not, why?

1.9. Which factor do you think affect the practical decision-making process for city planning the most?

1.9.1. Could you please explain how it affects with some examples? Please explain some more details about its influence on the overall and part of decision-making process for city planning.

1.10. Do city planners take the advices from you for city planning?

1.10.1. If yes, what advice will you provide? In which step should it be considered?
1.10.2. If no, why?
1.10.3. Do you think your advice affect the decision-making process?
1.10.4. If yes, how? If not, why?
1.10.5. Do you think your advices should be considered during the decision-making process? Why and how?

For third parties

1.11. Are you aware of the decision-making process for city planning?

1.11.1. If yes, could please explain the practical decision-making process in your city?
1.11.2. If not, why?

1.12. Have you ever been involved in decision-making process for city planning?

1.12.1. If yes, in which step are you involved? Does your involvement really contribute to the decision-making process, or just a token?
1.12.2. If not, why?

1.13. Do you think you should be involved in decision-making process for city planning?

1.13.1. If yes, in which step should you be involved and why?
1.13.2. If not, why?

1.14. How can you get involved in the decision-making process?

1.14.1. Which step should you be involved and how?
1.14.2. How can you contribute to the process?

1.15. Which factor do you think affect the practical decision-making process for city planning the most?

1.15.1. Could you please explain how it affects with some examples? Please explain some more details about its influence on the overall and part of decision-making process for city planning.

1.16. Do city planners take the advices from you for city planning?

1.16.1. If yes, what advice will you provide? In which step should it be considered?
1.16.2. If no, why?
1.16.3. Do you think your advice affect the decision-making process?
1.16.4. If yes, how? If not, why?
1.16.5. Do you think your advices should be considered during the decision-making process? Why and how?

2. To what extent, and how, is brownfield land considered within the city planning process?

For city planner

2.1 Do you think brownfield redevelopment is considered in decision-making process for city planning?

2.1.1 If yes, in which step is it considered? How is it considered? Can you give me some examples?
2.1.2 If not, why?

2.2 Do you think brownfield redevelopment should be considered in decision-making process for city planning?

2.2.1 If yes, why and how practically it should be considered? In which decision-making step?
2.2.2 If not, why?

2.3 When considering brownfield redevelopment in decision-making process for city planning, what information do you need?

2.3.1 From whom should you collect the information?
2.3.2 Is data collection and evaluation hard? Why?
2.3.3 How do you cooperate with those who provide relevant information of brownfield redevelopment?

2.4 What are the key challenges for considering brownfield redevelopment in decision-making process for city planning?

2.4.1 If no challenge, why it is not considered or is the current consideration effective?

2.4.2 If there are challenges, what is the current situation?

For brownfield redeveloper

2.5 Do you think brownfield redevelopment is considered in decision-making process for city planning?

2.5.1 If yes, in which step is it considered? How is it considered? Can you give me some examples?

2.5.2 If not, why?

2.6 Do you think brownfield redevelopment should be considered in decision-making process for city planning?

2.6.1 If yes, why and how practically it should be considered? In which decision-making step?

2.6.2 If not, why?

2.7 What are the key challenges for considering brownfield redevelopment in decision-making process for city planning?

2.7.1 If no challenge, why it is not considered or is the current consideration effective?

2.7.2 If there are challenges, what is the current situation and how to solve the potential problems?

2.8 When considering brownfield redevelopment in decision-making process for city planning, what information can you provide?

2.8.1 Do you think you are the main participants providing relevant information? What information can you provide?

2.8.2 Is data collection and evaluation hard? Why?

2.8.3 How do you cooperate with city planners to provide relevant information?

For third parties

2.9 Do you think brownfield redevelopment is considered in decision-making process for city planning?

2.9.1 If yes, in which step is it considered? How is it considered? Can you give me some examples?

2.9.2 If not, why?

2.10 Do you think brownfield redevelopment should be considered in decision-making process for city planning?

2.10.1 If yes, why and how practically it should be considered? In which decision-making step?

2.10.2 If not, why?

2.11 What are the key challenges for considering brownfield redevelopment in decision-making process for city planning?

2.11.1 If no challenge, why it is not considered or is the current consideration effective?

2.11.2 If there are challenges, what is the current situation and how to solve the potential problems?

2.12 When considering brownfield redevelopment in decision-making process for city planning, what information can you provide or how can you participate?

2.12.1 Do you think you are the main participants providing relevant information? What information can you provide?

2.12.2 How can you help with data collection and evaluation?

2.12.3 How do you cooperate with city planners and brownfield redeveloper in decision-making for city planning?

3. How does the consideration of brownfield land vary among selected cities, and how can similarities and differences be explained?

For city planner

3.1. What are the main features of your city for city planning and brownfield redevelopment comparing to other cities?

3.1.1. Are these features related to economic development or city sustainability?
3.1.2. Do these features related to decision-making for city planning? Why and how?
3.1.3. Do these features related to brownfield redevelopment? Why and how?

3.2. Are there many brownfields in your city?
3.2.1. Are you aware of the information of brownfields in your city?
3.2.2. If yes, how is the situation? Where do you get the information?
3.2.3. If not, why?

3.3. What are the main problems in brownfield redevelopment in your city comparing to other cities?
3.3.1. Are these problems related to city planning? Why?
3.3.2. Do you think taking brownfield redevelopment in city planning can solve these problems? Why and how?

For brownfield redeveloper

3.4. What are the main features of your city for city planning and brownfield redevelopment comparing to other cities?
3.4.1. Are these features related to economic development or city sustainability?
3.4.2. Do these features related to decision-making for city planning? Why and how?
3.4.3. Do these features related to brownfield redevelopment? Why and how?

3.5. Are there many brownfields in your city?
3.5.1. Are you aware of the information of brownfields in your city?
3.5.2. If yes, how is the situation? Where do you get the information?
3.5.3. If not, why?

3.6. What are the main problems in brownfield redevelopment in your city comparing to other cities?
3.6.1. Are these problems related to city planning? Why?
3.6.2. Do you think taking brownfield redevelopment in city planning can solve these problems? Why and how?

For third party

3.7. What are the main features of your city for city planning and brownfield redevelopment comparing to other cities?
3.7.1. Are these features related to economic development or city sustainability?
3.7.2. Do these features related to decision-making for city planning? Why and how?
3.7.3. Do these features related to brownfield redevelopment? Why and how?

3.8. Are there many brownfields in your city?
3.8.1. Are you aware of the information of brownfields in your city?
3.8.2. If yes, how is the situation? Where do you get the information?
3.8.3. If not, why?

3.9. What are the main problems in brownfield redevelopment in your city comparing to other cities?
3.9.1. Are these problems related to city planning? Why?
3.9.2. Do you think taking brownfield redevelopment in city planning can solve these problems? Why and how?

4. How might decision making processes for urban planning be improved in China in order to take better account of brownfield land and potential risks during redevelopment?

For city planner

4.1 Regarding the challenges you have just mentioned, how to solve them to better consider brownfield redevelopment in decision-making process for city planning?
4.1.1. Do you think the current regulation system (both city planning and brownfield redevelopment) needs to be improved?
4.1.2. How to solve the problems from practical point of view?

4.2 If considering brownfield redevelopment in decision-making process for city planning, how should you cooperate with other participants?
4.2.1 In which step should you cooperate? Why?

4.2.2 If cooperate with brownfield redeveloper, what information do you need and what advice you expect from them?
4.2.3 If cooperate with third parties (land user, etc.), what information do you need and what advice you expect from them?

4.3 Who should be responsible for taking brownfield redevelopment in decision-making process for city planning?
4.3.1 Why?
4.3.2 How should you cooperate with them?

For brownfield redeveloper

4.4 Regarding the challenges you have just mentioned, how to solve them to better consider brownfield redevelopment in decision-making process for city planning?
4.4.1 Do you think the current regulation system (both city planning and brownfield redevelopment) needs to be improved?
4.4.2 How to solve the problems from practical point of view?

4.5 If considering brownfield redevelopment in decision-making process for city planning, how should you cooperate with other participants?
4.5.1 In which step should you cooperate? Why?
4.5.2 If cooperate with city planner, what information and advice can you provide for them?
4.5.3 If cooperate with third parties (land user, etc.), what information do you need and what advice you expect from them?

4.6 Who should be responsible for taking brownfield redevelopment in decision-making process for city planning?
4.6.1 Why?
4.6.2 How should you cooperate with them?

For third party

4.1 Regarding the challenges you have just mentioned, how to solve them to better consider brownfield redevelopment in decision-making process for city planning?
4.1.1 Do you think the current regulation system (both city planning and brownfield redevelopment) needs to be improved?
4.1.2 How to solve the problems from practical point of view?

4.2 If considering brownfield redevelopment in decision-making process for city planning, how should you cooperate with other participants?
4.2.1 In which step should you cooperate? Why?
4.2.2 If cooperate with city planner, what information and advice can you provide for them?
4.2.3 If cooperate with brownfield redeveloper, what information and advice can you provide for them?

4.3 Who should be responsible for taking brownfield redevelopment in decision-making process for city planning?
4.3.1 Why?
4.3.2 How should you cooperate with them?

5 How does the situation and approach for brownfield land in Chinese cities compare with that found in other countries such as the UK?

3.5.3 Pilot data collection

The pilot study was carried out in Q District of Wuhan city in October 2017. It was selected for the three following reasons. Firstly, Q District belongs to Wuhan city, and the pilot study can therefore simulate the full formal survey process to be conducted in Wuhan city later, thereby also helping in further communicating with other participants

in Wuhan city. Secondly, the participants in this pilot study were within the district level and the pilot study would not use those participants targeted for the full formal survey at this stage; Thirdly, WISCO – a state-owned industry with brownfield sites - is located in Q District and has strong power and good communication with the local government and other participants. Through WISCO, it was possible to access suitable participants and test the credibility of this pilot survey.

The pilot survey was carried out from October to December 2017, with face-to-face questionnaire and interview participation. Before the survey, each individual participant was provided with information stating the research aims and asking for their consent to take part in the survey. Nearly 60% of the participants were willing to take the questionnaire, indicating the accessibility of this questionnaire is acceptable. During the questionnaire process, the participants asked for some clarification for some specific questions, and thus the interviewer (myself) stayed together with them and explained the meaning of each question. All their concerns or suggestions were recorded, to help further improve the quality and clarify of the questionnaire, ready for the full formal survey. The pilot questionnaire took on average 15 minutes to complete, with participants taking a range of between 8 to 25 minutes.

After each questionnaire, the participants were asked whether had time or were willing to take the following interview. About 20% of them agreed to take the interview. They were asked questions from No. 1 to No. 10, and detailed follow-up or supplementary questions were asked or not, according to their response. On average, each interview took about 20 minutes

All the questionnaire sheets were carefully stored for further data analysis. All the interviews were recorded electronically and the key points were summarized as bullet points for further analysis.

3.6 Formal survey

3.6.1 Design of the questionnaire

From the results of the pilot study, the quantitative questionnaire was found to be a good approach to collect data, as planned. The majority of members from different departments accepted to participate in the questionnaire, rather than interview and it took a reasonable time for each individual participant to complete it.

However, the pilot showed that some questions were not necessary or could not provide

valuable information, such as the age and position of the participants. Accordingly, they were removed in the formal questionnaire sheet. Additionally, participants offered some suggestions on all the 12 questions in Part 2 and they were further modified to improve their quality and accessibility by participants. The new questionnaire for the formal full survey was designed with 14 questions, which had multiple choices for the participants, as follows:

Q1 to Q6 have the aim to identify the purposes of city planning and the importance of driving forces. Participants were asked to answer:

1) What is the main purpose of city planning in your city?
2) Which of the following factors is the key driving force affecting decision making for city planning?
3) What is the importance of the following driving force affect decision making for city planning?
4) What is the importance of the following driving forces on the land use and planning?
5) How do the following driving forces affect the brownfield redevelopment?

Q7 to Q12 attempt to reveal the current and ideal situation of involvement of decision making in planning, and brownfield development processes from three perspectives, including:

6) Are brownfield redevelopers and third parties currently involved in decision making for city planning?
7) In a well-established and proper city planning process, should brownfield redevelopers and third parties be involved in decision making for city planning?
8) Are your aware of the decision-making process for city planning and brownfield redevelopment?
9) How does a city planner consider brownfield redevelopment in decision making for city planning?
10) Are you aware of the following issues related to brownfield redevelopment?
11) What do you think about the current roles of the city planner in brownfield redevelopment?
12) What do you think are the most appropriate roles of city planners in brownfield redevelopment in an ideal situation?

Questions 13-14 are designed for understanding of the ideal process(es) of involvement in the decision-making process, including:

13) How should city planners, brownfield redevelopers and third parties be involved in decision making for city planning?
14) How should city planners, brownfield redevelopers and third parties be involved in decision making for brownfield redevelopment?

For each question, the options were adjusted from the results in the pilot survey. Details are given in Table 3.4.

Table 3.4 Formal questionnaire sheet.

1. What is the main purpose of city planning in your city?

	Priority	Neutral	Less priority
To improve economic development			
To improve urbanization level			
To improve infrastructure construction			
To improve city sustainability			
To improve urban environment			

2. Which of the following factors is the key driven force affecting decision making for city planning?
   A. Central government or national plan
   B. Local economic development
   C. Local sustainable development
3. What is the importance of the following driven forces on the land use and planning? (1 for least important and 5 for most important)

	1	2	3	4	5
Central government or national plan					
Local economic development					
Local sustainable development					

4. How does the following driven force affect decision making for city planning? (1 for least important and 5 for most important)

	1	2	3	4	5
Central government or national plan					
Local economic development					
Local sustainable development					

5. How do the following driven forces affect the brownfield redevelopment? (1 for least important and 5 for most important)

	1	2	3	4	5
Central government or national plan					
Local economic development					
Local sustainable development					

6. Are brownfield redeveloper and third party currently involved in decision making for city planning? (1 for least involvement and 5 for most involvement)

	1	2	3	4	5
Brownfield redeveloper					
Third party					

7. In a well-established and proper city planning process, should brownfield redeveloper and third party be involved in decision making for city planning? (1 for least involvement and 5 for most involvement)

	1	2	3	4	5
Brownfield redeveloper					
Third party					

8. Are your aware of the decision-making process for city planning and brownfield redevelopment?

	Completely unclear	Limited	To some extent	Completely Clear
City planning				
Brownfield redevelopment				

9. How does city planner consider brownfield redevelopment in decision making for city planning?
   A. Do not consider.
   B. Consider a little. Only mark the brownfield site for further redevelopment, but the site function and land use are only based on the purpose of city planning.
   C. Consider to some extent. City planner will use site information and design its function

or land use, with appropriate evaluation of remediation target, remediation cost or remediation time. Combine this information and city planning purpose to make the most appropriate decision.

D. Full consider. City planner will collect full information of the brownfield, discussion comprehensively with brownfield redeveloper and land user to well design the remediation target, cost and time. After choosing the most appropriate alternative, consider it together with city planning purpose and make the best decision.

10. Are you aware of the following issues related to brownfield redevelopment?

	Completely unclear	Limited	To some extent	Completely Clear
Current situation of land use				
Contamination level of land use				
Number and location of brownfield				
Contamination level of brownfield				

11. What do you think about the current roles of city planner in brownfield redevelopment?
    A. No direct role. City planner is not involved in brownfield redevelopment and all the key issues are determined by brownfield redeveloper and land user.
    B. Limited role. City planner provides advices for the land use and function for brownfield redevelopment, but the key decision maker is brownfield redeveloper.
    C. Some important role. City planner and brownfield redeveloper work together on the land use and functions, determining remediation target, cost, strategy and other relevant issues for better decision in brownfield redevelopment.
    D. Most important role. City planner determine the land use and function in city planning. Brownfield redevelopment must follow what is required in city plan, and add detailed strategies to achieve redevelopment target.
12. What do you think about the most appropriate roles of city planner in brownfield redevelopment?
    A. No involvement. City planners are not expert in brownfield and the land use and function should be decided by brownfield redeveloper. City planner must take the decision of brownfield redeveloper during city planning process.
    B. Limited advice. Brownfield redevelopers should balance the remediation target, cost, strategy and future land use. City planner can provide some suggestions to maximize the values of land future use, but it is only one of the key factors in brownfield redevelopment.
    C. Well negotiation. Both brownfield redeveloper and city planner have the same goal but doing things in different ways. The remediation target, cost, strategy and future land use should be well discussed and agreed between these two groups. Both achievability and economic-cost effectiveness should be well balanced.
    D. Strong power. Brownfield redevelopment is working for city plan and it must follow the requirement of city plan. Brownfield redeveloper is only responsible for carrying out redevelopment project, but cannot decide land use and function.
13. How much should brownfield redeveloper and third party be involved in decision making for city planning? (1 for least involvement and 5 for most involvement)

	1	2	3	4	5
City planner					
Brownfield redeveloper					
Third party					

14. In a well-established and proper brownfield redevelopment process, should brownfield redeveloper and third party be involved in brownfield redevelopment? (1 for least involvement and 5 for most involvement)

	1	2	3	4	5
City planner					
Brownfield redeveloper					
Third party					

3.6.2 Design of the full formal interview

From the results of the pilot study, the interview question lists were entirely revised. First, it was necessary to set up different questions for different groups of participants, with some specific questions for different groups of participants Thus, all the questions for different group of participants were separated and reorganized into 10 questions. Secondly, in the pilot survey, experience showed that with open questions the interview process took a relatively long time to conduct, which meant that some participants did not answer all the questions. To improve it, for each of these key questions, about 3-4 sub-questions were carefully designed to cover some key aspects from the key questions to direct the interview process and save time to ensure most of the interviewers can complete the who interview.

Table 3.5 Question lists for formal interview

For city planners
1. Can you briefly describe the key steps in decision making for city planning? Is this decision making for city planning step by step (incremental) or in one go (rationale)? 1) If in one go, how is the information collected and validated for decision making? Could please give me some examples to show the practical decision-making process for city planning? Is there any people or authority showing strong power in decision making for city planning? What are the roles of other participants in decision making process or how do the other participants help with the rationale decision making? How do they negotiate to provide sufficient information in decision making for city planning? 2) If step by step, how many key steps are involved? How do decision makers set up goal for each step and muddle through them? What is the normal way to adjust decision when finding new problems? Is there any key player in specific step? Do you think it is really a step-by-step process?
2. Does the practical city planning process follow "National Urban and Rural Planning" Art? Do you think the practical decision-making process for city planning is the same as national guideline? 1) If yes, is the city planning "consistent with land use planning" and "comply with the corresponding environmental laws and regulations"? 2) If not, what is the main difference? What is the main reason causing such difference?
3. Which is the key driven force for city planning in your city? 1) Why is it important? Is it closed linked to the purpose of city planning? 2) Of central plan, local economic development and sustainable development, which one can cause the difference the most? 3) If central government plan is the key driven force, do you consider brownfield redevelopment without such restriction? Why? Is it related to the industrial history or industrial level in your city? 4) If economic development is the key driven force, do you think the city planning will be adjusted if the city economy is highly developed in the future? 5) If city sustainability is the key driven force, do you think brownfield redevelopment is the priority to improve it? Is there any specific regulation regarding brownfield redevelopment in city planning or practices? If yes, why? If not, which one is and has city planning consider that?
4. Do you think the current decision-making process for city planning is effective? 1) If yes, why do you think it is effective? Which step is the most effective one? Can you give an example to show how effective it is? 2) If not, why? Which step is the least effective one? Can you give an example to show the reason causing the less effectiveness? 3) Do you want to make some change in decision-making process to improve its effectiveness?
5. Is brownfield redevelopment considered in the decision-making process for city planning? 1) If yes, how is it considered? Simply marked for brownfield redeveloper to design the strategies, or take advices from brownfield redeveloper during decision making? 2) If not, why? Then how about the brownfield? Is it planned as clean field? Could you please give some examples about considering or not considering brownfield redevelopment during city planning process?
6. Are you aware of brownfield situation in your city? 1) If no, what is the reason for that? Have you ever tried to get information about brownfield? Why are you not able to collect the information? Do you think the awareness of brownfield situation is important for city planning? 2) If yes, to what extent are you aware? Where do you get the information from? Do you think the current information is sufficient? Do you think the awareness of brownfield situation is important for city planning?
7. What do you think is your roles in brownfield redevelopment? 1) Are you the key decision maker in brownfield redevelopment, in terms of setting land use (remediation target)? Or do you have more key roles in brownfield redevelopment, such as setting the remediation budget or strategies? Could you please give some

examples showing your roles?

2) Do you think have some important roles in brownfield redevelopment, but the brownfield redeveloper is the key decision maker? Could you please give an example of how the decision of brownfield redevelopment is made?
3) Do you think you have minor roles in brownfield redevelopment? Does brownfield redeveloper decide the brownfield redevelopment, and provides advices for future land use, remediation target and remediation strategies? Could you please give an example of how the decision of brownfield redevelopment is made?
4) Do you think you are not involved in brownfield redevelopment? Could you please give an example of how the decision of brownfield redevelopment is made?

8. How about your relationship with brownfield redeveloper and third party?
   1) For city planning, is the city plan "released to the public and expert seeking for their advice"? Do you think the help of third party and other experts can improve the effectiveness of decision making? In which step are they involved? Could you please give some example to show their involvement? Is their involvement effective, or how do you take their advices?
   2) For brownfield redevelopment, is the brownfield redeveloper involved in the decision making for city planning? How are they involved? Could you please give some example to show their involvement? Is their involvement effective, or how do you take their advices?
   3) For brownfield redevelopment, are you involved in practical process? If not, why? Do you think you should participate? If yes, how? In which step are you involved? What is your main role in brownfield redevelopment? Is this mode effective? Which one is more important, city planner, brownfield redeveloper or third party, in brownfield redevelopment?
9. What do you think about the relationship between city planning and brownfield redevelopment?
   1) Do you think city planning and brownfield redevelopment are entirely separated? Why do you think so?
   2) Do you think there is some link between city planning and brownfield redevelopment, but it is weak? Which part should they be linked together: future land use, remediation target, remediation strategy, time table, etc.? In each part, who should lead the decision making? How should they negotiate with each other?
   3) Do you think there is strong link between city planning and brownfield redevelopment? Why do you think there is a strong link? Which part should they be linked together: future land use, remediation target, remediation strategy, time table, etc.? In each part, who should lead the decision making? How should they negotiate with each other? Is the current decision making for city planning support this mode? If not, how to improve the scheme?
   4) Do you think there is city planning and brownfield redevelopment should be considered together for their very strong correlation? In which mode do you think they should work together? How should they negotiate with each other? Is the current decision making for city planning support this mode? If not, how to improve the scheme?
10. Any suggestions for further city planning and brownfield redevelopment?
    1) To consider brownfield redevelopment during urbanization process, which one is the key part, city planning and brownfield redevelopment?
    2) Are you satisfied with current brownfield redevelopment? What is the main problems? Can you give me some example to show the problem? What is the main reason causing the problem? Do you think the collaboration between city planner and brownfield redeveloper can solve the problem?
    3) Finally, could you please give some practical advices how to improve brownfield redevelopment during decision making for city planning?

For brownfield redevelopers

1. Which is the key driven force for brownfield redevelopment in your city?
   1) Why is it important? Is it closed linked to the city planning?
   2) Of central plan, local economic development and sustainable development, which one is the more important for brownfield redevelopment? Is this driven force specific in

your city?
   3) If central government plan is the key driven force, what do you consider in brownfield redevelopment? Why? Is it related to the industrial history or industrial level in your city?
   4) If economic development is the key driven force, what do you consider in brownfield redevelopment? Why? Is it related to city planning?
   5) If city sustainability is the key driven force, what do you consider in brownfield redevelopment? Is there any specific regulation regarding brownfield redevelopment practices? If yes, why? If not, how to you use brownfield redevelopment to improve city sustainability?
2. To what extent are you aware of brownfield situation in your city?
   1) If no, what is the reason for that? Have you ever tried to get information about brownfield? Why are you not able to collect the information? How do you think it can be improved? Which types of information are more important for brownfield redevelopment? Do you think the awareness of brownfield situation is important for you and other government officers?
   2) If yes, where do you get the information from? Do you think the current information is sufficient? How can you get more information? What is the barrier for sufficient information to be collected? Do you think the awareness of brownfield situation is important for you and other government officers?
3. Are you familiar with the decision making for city planning? Is this decision making for city planning step by step (incremental) or in one go (rationale)?
   1) If not familiar, why? Do you think you should be aware of decision making for city planning?
   2) If in one go, how is the information collected and validated for decision making? Could please give me some examples to show the practical decision-making process for city planning? Is there any people or authority showing strong power in decision making for city planning? What are the roles of brownfield redeveloper in decision making process? How do you negotiate with city planner to provide sufficient information in decision making for city planning?
   3) If step by step, how many key steps are involved? How do decision makers set up goal for each step and muddle through them? What is the normal way to adjust decision when finding new problems? Is there any key player in specific step? Do you think it is really a step-by-step process? Which step are you involved? Is your involved effective?
4. Do you think the current decision-making process for city planning is effective?
   1) Does the practical city planning process follow “National Urban and Rural Planning” Art? Do you think the practical decision-making process for city planning is the same as national guideline?
   2) If decision-making for city planning is effective, why? Which step is the most effective one? Can you give an example to show how effective it is?
   3) If not, why? Which step is the least effective one? Can you give an example to show the reason causing the less effectiveness?
5. Which is the key driven force for city planning in your city?
   1) Why is it important? Is this driven force also affects brownfield redevelopment?
   2) Of central plan, local economic development and sustainable development, which one can cause the difference the most?
   3) If central government plan is the key driven force, does city planner consider brownfield redevelopment? Why? Is it related to the industrial history or industrial level in your city?
   4) If economic development is the key driven force, do you think the city planning will be adjusted if the city economy is highly developed in the future?
   5) If city sustainability is the key driven force, do you think brownfield redevelopment is the priority to improve it? Is there any specific regulation regarding brownfield redevelopment in city planning or practices? If yes, why? If not, which one is and has city planning considered that?
6. Is brownfield redevelopment considered in the decision-making process for city planning?

1) If yes, how is it considered? Are you simply given the tasks to for brownfield redevelop or asked for advices during decision making for city planning? Are your advices considered in city planning?
2) If not, why? How about the site is found as brownfield after city planning? Could the city planning be adjusted in this situation? Could you please give some examples about considering or not considering brownfield redevelopment during city planning process?

7. What do you think is the roles of city planner in brownfield redevelopment?
   1) Is the city planner the key decision maker in brownfield redevelopment, in terms of setting land use (remediation target)? Or does city planner has more key roles in brownfield redevelopment, such as setting the remediation budget or strategies? Could you please give some examples showing their roles?
   2) Do you think the city planner has some important roles in brownfield redevelopment, but you are the key decision maker? Could you please give an example of how the decision of brownfield redevelopment is made?
   3) Do you think city planner has minor roles in brownfield redevelopment? Do you decide the brownfield redevelopment, and provide advices for future land use, remediation target and remediation strategies? Could you please give an example of how the decision of brownfield redevelopment is made?
   4) Do you think city planner is not involved in brownfield redevelopment? Could you please give an example of how the decision of brownfield redevelopment is made?
8. How about your relationship with city planner and third party?
   1) For city planning, is the city plan "released to the public and expert seeking for their advice"? Do you think the help from you and other experts can improve the effectiveness of decision making for city planning? In which step are you involved? Could you please give some example to show their involvement? Is your involvement effective, or how does city planner take your advices?
   2) For brownfield redevelopment, how are you involved in the decision making for brownfield redevelopment? Could you please give some example to show your roles? Is your role effective, or how do you take the advices from others?
   3) For brownfield redevelopment, are city planner and third party involved in practical process? If not, why? Do you think they should participate? If yes, how? In which step are they involved? What is their main role in brownfield redevelopment? Is this mode effective? Which one is more important, city planner, brownfield redeveloper or third party, in brownfield redevelopment?
9. What do you think about the relationship between city planning and brownfield redevelopment?
   1) Do you think city planning and brownfield redevelopment are entirely separated? Why do you think so?
   2) Do you think there is some link between city planning and brownfield redevelopment, but it is weak? Which part should they be linked together: future land use, remediation target, remediation strategy, time table, etc.? In each part, who should lead the decision making? How should they negotiate with each other?
   3) Do you think there is strong link between city planning and brownfield redevelopment? Why do you think there is a strong link? Which part should they be linked together: future land use, remediation target, remediation strategy, time table, etc.? In each part, who should lead the decision making? How should they negotiate with each other? Is the current decision making for city planning support this mode? If not, how to improve the scheme?
   4) Do you think there is city planning and brownfield redevelopment should be considered together for their very strong correlation? In which mode do you think they should work together? How should they negotiate with each other? Is the current decision making for city planning support this mode? If not, how to improve the scheme?
10. Any suggestions for further city planning and brownfield redevelopment?
    1) To consider brownfield redevelopment during urbanization process, which one is the key part, city planning and brownfield redevelopment?
    2) Are you satisfied with current brownfield redevelopment? What is the main problems?

Can you give me some example to show the problem? What is the main reason causing the problem? Do you think the collaboration between city planner and brownfield redeveloper can solve the problem?

3) Finally, could you please give some practical advices how to improve brownfield redevelopment during decision making for city planning?

For members from third party

1. Are you familiar with the decision making for city planning? Is this decision making for city planning step by step (incremental) or in one go (rationale)?
   1) If not familiar, why? Do you think you should be aware of decision making for city planning?
   2) If in one go, how is the information collected and validated for decision making? Could please give me some examples to show the practical decision-making process for city planning? Is there any people or authority showing strong power in decision making for city planning? What are the roles of brownfield redeveloper in decision making process? How do you negotiate with city planner to provide sufficient information in decision making for city planning?
   3) If step by step, how many key steps are involved? How do decision makers set up goal for each step and muddle through them? What is the normal way to adjust decision when finding new problems? Is there any key player in specific step? Do you think it is really a step-by-step process? Which step are you involved? Is your involved effective? Which step is brownfield redeveloper involved?
2. Do you think the current decision-making process for city planning is effective?
   1) Does the practical city planning process follow "National Urban and Rural Planning" Art? Do you think the practical decision-making process for city planning is the same as national guideline?
   2) If decision-making for city planning is effective, why? Which step is the most effective one? Can you give an example to show how effective it is?
   3) If not, why? Which step is the least effective one? Can you give an example to show the reason causing the less effectiveness?
3. Which is the key driven force for city planning in your city?
   1) Why is it important? Is this driven force also affects brownfield redevelopment?
   2) Of central plan, local economic development and sustainable development, which one can cause the difference the most?
   3) If central government plan is the key driven force, does city planner consider brownfield redevelopment? Why? Is it related to the industrial history or industrial level in your city?
   4) If economic development is the key driven force, do you think the city planning will be adjusted if the city economy is highly developed in the future?
   5) If city sustainability is the key driven force, do you think brownfield redevelopment is the priority to improve it? Is there any specific regulation regarding brownfield redevelopment in city planning or practices? If yes, why? If not, which one is and has city planning considered that?
4. Which is the key driven force for brownfield redevelopment in your city?
   1) Why is it important? Is it closed linked to the city planning?
   2) Of central plan, local economic development and sustainable development, which one is the more important for brownfield redevelopment? Is this driven force specific in your city?
   3) If central government plan is the key driven force, what do you consider in brownfield redevelopment? Why? Is it related to the industrial history or industrial level in your city?
   4) If economic development is the key driven force, what do you consider in brownfield redevelopment? Why? Is it related to city planning?
   5) If city sustainability is the key driven force, what do you consider in brownfield redevelopment? Is there any specific regulation regarding brownfield redevelopment practices? If yes, why? If not, how to you use brownfield redevelopment to improve city sustainability?
5. To what extent are you aware of brownfield situation in your city?

1) If no, what is the reason for that? Have you ever tried to get information about brownfield? Where should the information come from? Do you think brownfield redeveloper is responsible for that? How do you think it can be improved? Which types of information are more important for brownfield redevelopment? Do you think the awareness of brownfield situation is important for you and other government officers?
2) If yes, where do you get the information from? Do you think brownfield redeveloper is responsible for that? Do you think the current information is sufficient? What is the barrier for sufficient information to be collected? Do you think the awareness of brownfield situation is important for you and other government officers?

6. Is brownfield redevelopment considered in the decision-making process for city planning?
   1) If yes, how is it considered? Is brownfield redeveloper simply given the tasks to for brownfield redevelop or asked for advices during decision making for city planning? Are their advices considered in city planning?
   2) If not, why? How about the site is found as brownfield after city planning? Could the city planning be adjusted in this situation? Could you please give some examples about considering or not considering brownfield redevelopment during city planning process?
7. What do you think is the roles of city planner in brownfield redevelopment?
   1) Is the city planner the key decision maker in brownfield redevelopment, in terms of setting land use (remediation target)? Or does city planner has more key roles in brownfield redevelopment, such as setting the remediation budget or strategies? Could you please give some examples showing their roles?
   2) Do you think the city planner has some important roles in brownfield redevelopment, but brownfield redeveloper is the key decision maker? Could you please give an example of how the decision of brownfield redevelopment is made?
   3) Do you think city planner has minor roles in brownfield redevelopment? Does brownfield redeveloper decide the brownfield redevelopment, and provide advices for future land use, remediation target and remediation strategies? Could you please give an example of how the decision of brownfield redevelopment is made?
   4) Do you think city planner is not involved in brownfield redevelopment? Could you please give an example of how the decision of brownfield redevelopment is made?
8. How about your relationship with city planner and brownfield redeveloper?
   1) For city planning, is the city plan "released to the public and expert seeking for their advice"? Do you think the help from you and other experts can improve the effectiveness of decision making for city planning? In which step are you involved? Could you please give some example to show their involvement? Is your involvement effective, or how does city planner take your advices?
   2) For brownfield redevelopment, are you involved in the decision making for brownfield redevelopment? How are you involved? Could you please give some example to show your involvement? Is your involvement effective, or how do they take your advices?
   3) For brownfield redevelopment, are city planner and you involved in practical process? If not, why? Do you think all of you should participate? If yes, how? In which step are they involved? What is their main role in brownfield redevelopment? Is this mode effective? Which one is more important, city planner, brownfield redeveloper or third party, in brownfield redevelopment?
9. What do you think about the relationship between city planning and brownfield redevelopment?
   1) Do you think city planning and brownfield redevelopment are entirely separated? Why do you think so?
   2) Do you think there is some link between city planning and brownfield redevelopment, but it is weak? Which part should they be linked together: future land use, remediation target, remediation strategy, time table, etc.? In each part, who should lead the decision making? How should they negotiate with each other?
   3) Do you think there is strong link between city planning and brownfield redevelopment? Why do you think there is a strong link? Which part should they be linked together: future land use, remediation target, remediation strategy, time table, etc.? In each part, who should lead the decision making? How should they negotiate with each other? Is

the current decision making for city planning support this mode? If not, how to improve the scheme?

4) Do you think there is city planning and brownfield redevelopment should be considered together for their very strong correlation? In which mode do you think they should work together? How should they negotiate with each other? Is the current decision making for city planning support this mode? If not, how to improve the scheme?

10. Any suggestions for further city planning and brownfield redevelopment?
    1) To consider brownfield redevelopment during urbanization process, which one is the key part, city planning and brownfield redevelopment?
    2) Are you satisfied with current brownfield redevelopment? What is the main problems? Can you give me some example to show the problem? What is the main reason causing the problem? Do you think the collaboration between city planner and brownfield redeveloper can solve the problem?
    3) Finally, could you please give some practical advices how to improve brownfield redevelopment during decision making for city planning?

3.6.3 Data collection

The full formal survey was carried out in three cities as planned. These were Wuhan (from March to April 2018), Guangzhou (from May to July 2018) and Shenyang (from July to August 2018).

In each city and from the experience of the pilot survey, the survey started with academic staff for three reasons:

1. Local academic researchers were contacted initially, to obtain basic information about city planning and brownfield redevelopment, thus making good communication and negotiation initially.

2. Most of these academic staff had been in the area for over 10 years and were more familiar with both city planning and brownfield redevelopment than other groups of participants.

3. Most had worked as members of third parties and had therefore worked with city planners or brownfield redevelopers previously. They therefore provided a bridge to link the two groups of participants and by starting with them the survey process benefitted.

Officers from government were the next target participants as they had important roles in decision-making for city planning. Taking the experience from the pilot survey, the process was improved by contacting the director or leader of divisions in each department, institute or company, so they could bring the whole group of people within the division toa group meeting. In this way, it was easier to talk directly with 3-5 participants together, to explain the aims and objectives of this research and highlight some key points related to the survey. They could then fill in the questionnaire individually. Members from third parties were the group of participants addressed last.

Similar as officers in government, the head of companies or other third-party institutes/enterprises were contacted directly and asked to help to organize a small group meeting, and then the questionnaire and survey.

In each city, face-to-face questionnaire surveys and interviews were carried out. Similar to the pilot study, each individual participant was provided with background notes about the research aims, before taking the questionnaire and interview, and to get their permission to participate. With the group meetings to introduce the formal survey, over 80% of the participants were willing to take the questionnaire – a much higher success rate than with the pilot study. As with the pilot study, during the questionnaire process, the participants asked for some clarification for some specific questions, and thus the interviewer (myself) stayed together with them and explained the meaning of each question. Each questionnaire took about15 minutes, on average, to complete, with the range from 8 to 25 minutes.

After the questionnaire, all the participants were asked whether they would take the interview; around 25% participated. Based on which group they belonged to, different questions were asked, as described above. The average interview time for each participant was about 15 minutes.

All the questionnaire sheets were carefully stored for further data analysis. All the interviews were recorded electronically and the key points were summarized as bullet points for further analysis.

3.7 Data analysis

For the quantitative questionnaire, the credibility test was carried out by Cronbach's α coefficient in Alpha model to evaluate the internal consistency reliability (Wilkinson, 1999) and Guttman split-half reliability in Split-half model to evaluate the split-half reliability in SPSS (Heale and Twycross, 2015). These two tests attempt to assess whether the results of the questionnaire are objective or non-psychometric and ensure further quantitative analysis is reasonable.

The validity test was applied as face validity, content validity and construct validity, based on the comprehensive analysis of responses of individual participants. These validity tests aim to evaluate the degree of correlation between questions in the questionnaire and research aims, questions in questionnaire cover the range of key concepts, and research hypothesis addressed in the questionnaire. All the qualified data were subsequently validated for normality by the Brown-Forsythe test prior to a one-

way analysis of variance (ANOVA) followed by Duncan's test. Brown-Forsythe test aims to assess the data distribution and determine which statistical method is applicable for these data sets. If the Brown-Forsythe test is passed, ANOVA is introduced for the comparison of option selection between different groups of participants, and difference with $p<0.05$ level is significant. Pearson's correlation analysis and principal component analysis (PCA) was carried out by SPSS to uncover the link between option selection of each question in questionnaire and obtain their coherent relationship.

For the qualitative interviews, all the answers were recorded, evaluated for their length and questions covered by each interviewee, and further categorized into three groups with different quality (high, medium and low). Those with long interview time and more questions were highlighted and fully translated into English for comprehensive analysis. Their opinions for each interview questions were then combined and analyzed for the similarity. Then, similar statistical analysis like that in questionnaire results were carried out by using ANOVA and SPSS to summarize the main findings. Subsequently, interviewees' answers in other groups were suspended in database and searched for further discussion in parallel with other answers.

4. Survey quality evaluation

4.1 Survey summary

In total, 196 participants took the formal survey, including 88 participants in Wuhan, 54 in Guangzhou and 54 in Shenyang, as listed in Table 4.1. Of them, 63 participants were city planners, 73 fell in the group of brownfield redevelopers, and 61 were members of third party. Except for the relatively higher and lower number of brownfield redevelopers who were surveyed in Wuhan and Guangzhou, respectively, the numbers of all participants (city planners, brownfield redevelopers and members from third party) are similar for each city. Additionally, the members in each group of participants contributed to over 30% of the total numbers, and the members from each city account for at least 25% of all the participants. Accordingly, the selection of members from three stakeholder groups and from three target cities should have no subjective bias, and the outcomes of this survey can reflect the situation of how brownfield redevelopment is considered in decision-making process for city planning in the three cities.

Table 4.1 Number of participants taking questionnaire in three cities.

City	City planners	Brownfield redevelopers	Members from third party	Total
Wuhan	25	45	18	88
Shenyang	17	17	20	54
Guangzhou	21	11	23	55
Total	63	73	61	197

All the 197 participants took the questionnaire and among them, 66 individuals agreed to take the interview and their answers were recorded for qualitative analysis. To be more precise, 18 interviewees were from Guangzhou city, 10 from Shenyang city and 38 from Wuhan city. As for categories based on the groups of decision-makers, 10 of them were city planners, 21 belonged to brownfield redevelopers, and 35 were members from third party.

4.2 Reliability test

4.2.1 Internal consistency reliability

Reliability is critical for the survey, to prove the results are not subjective or psychometric. Reliability assessments are therefore appropriate to evaluate whether the outcomes of a survey or questionnaire are reliable, by calculating the reliability coefficients of scores of each question in a survey (Wilkinson, 1999). Normally, internal consistency is regarded as an appropriate indicator in reliability assessment, which is related to the homogeneity of answers in a test. Evaluation of internal consistency reliability is important in a survey as the test results might be inappropriately obtained without a confident knowledge of error measurement (Elmore et al., 1993). There are many measures for internal consistency, and the most popular one is to use Cronbach's alpha which is an indicator evaluating the internal consistency reliability. Given variable x_1, ..., x_k and $x_0 = \sum_{j=1}^{k} x_k$, Cronbach's alpha is defined in the following Equation (4.1).

$$\text{Cronbach's alpha} = \frac{k}{k-1}\left(\frac{\sum_{i\neq j}^{k} cov(x_i, x_j)}{var(x_0)}\right) \tag{4.1}$$

Here, k is the number of questions, $cov(x_i, x_j)$ refers to the covariance of answers to questions i and , and $var(x_0)$ represents the variance of x_0. Generally, Cronbach's alpha represents satisfactory internal consistency reliability when it is above 0.7 and low internal consistency reliability in range of 0 to 0.7.

In the present study, Cronbach's coefficient alpha of formal survey is 0.787 from Alpha-test in SPSS, suggesting a satisfactory internal consistency reliability. The questionnaire therefore has a high level of internal consistency for further data analysis.

4.2.2 Split-half reliability

Another measure of consistency to test the reliability of questionnaire is split-half test, which splits the total scores of the whole questionnaire results in two and compares the scores for each half to test the consistency of different score groups (Heale and Twycross, 2015). Guttman split-half reliability represents the consistency by randomly splitting the questionnaire into half, and higher data refer to equal answers within the split groups and high level of split-half reliability. λ is the most accepted parameters in Guttman split-half reliability, which is calculated in the following Equation (4.2).

$$\lambda = \frac{4cov(h_1, h_2)}{var(total)} \tag{4.2}$$

where h_1 represents the partial scores of questions from the first half of questionnaire, and h_2 represents the partial scores of questions from the second half. $cov(h_1, h_2)$ is the coefficient of variance between groups of h_1 and h_2, and $var(total)$ represents the total scores of the whole questionnaire results. Generally, λ in Guttman split-half reliability test represents satisfactory reliability when it is above 0.5 and low reliability in range of 0 to 0.5.

In the present study, λ in Guttman split-half reliability test is 0.608 from calculation in SPSS, suggesting a satisfactory consistency reliability. The questionnaire therefore has a high level of consistency for further data analysis.

4.3 Validity test

Three validity tests were introduced in this study to test the validity of the questionnaire, including face validity to evaluate the correlation between questions in questionnaire and the research aims and objectives, content validity to assess the degree to which the questions in questionnaire cover the range of key concepts correlated with the research topic, and construct validity to test whether the research hypothesis is addressed and answered in the questionnaire.

4.3.1 Face validity

Face validity aims to evaluate whether the questions in the questionnaire are closely correlated with the research aims and objectives, and whether appropriate participants were selected for this survey. Here, the approach used to test the face validity was to obtain feedback from participants about the goodness of each individual question, or which of the questions is clearest or closest to the research questions. Subsequently, each individual question in the questionnaire is marked from their link to the research aims and data quality.

Links to the research aims represent whether the question is set for answering research questions directly and the results from this question can help in better understanding the relationship between city planning and brownfield redevelopment. After each questionnaire, the participant was asked to point out which question was the most obscure or had the weakest relationship with the research topic. For the questions not raised by participants, 3 stars are given. Questions noted by less than 5 participants were marked as 2 stars, and those criticized by more than 5 participants were marked with 1 star.

Data quality refers to the level that participants understand the questions properly and answer the questions without asking for help. It is evaluated by the response of participants during the questionnaire survey. If the questions are easily understood by the participants and they are fully aware of the answers, they are of high quality and marked with 3 stars. For questions either asked by participants to understand its meaning, answered with hesitation, or criticized by participants are of moderate quality and marked with 2 stars. Questions with more than one problem or debated by many participants are of poor quality and marked with 1 star.

Table 4.2 Scores of face validity test for questionnaire.

Question number	Question	Link to research aims	Data quality
Q1	What is the main purpose of city planning in your city	★	★★
Q2	Which of the following factors is the key driven force affecting decision making for city planning	★★	★★★
Q3	What is the importance of the following driven force affect decision making for city planning	★★	★★★
Q4	What is the importance of the following driven forces on the land use and planning	★★	★★
Q5	How do the following driven forces affect the brownfield redevelopment	★★	★★★
Q6	Are brownfield redeveloper and third party currently involved in decision making for city planning	★★★	★★★
Q7	In a well-established and proper city planning process, should brownfield redeveloper and third party be involved in decision making for city planning	★★★	★★★
Q8	Are your aware of the decision-making process for city planning and brownfield redevelopment	★★	★★★
Q9	How does city planner consider brownfield redevelopment in decision making for city planning	★★★	★★
Q10	Are you aware of the following issues related to brownfield redevelopment	★★★	★★★
Q11	What do you think about the current roles of city planner in brownfield redevelopment	★★★	★★★
Q12	What do you think about the most appropriate roles of city planner in brownfield redevelopment in ideal situation	★★★	★★★
Q13	How should city planner, brownfield redeveloper and third party be involved in decision making for city planning	★★★	★★
Q14	How should city planner, brownfield redeveloper and third party be involved in decision making for brownfield redevelopment	★★★	★

★★★: Strong link to research aims and good data quality. ★★: Moderate link to research aims and data quality. ★: Poor link to research aims and data quality.

Generally, five questions (Q6, Q7, Q10, Q11 and Q12) show strong links with the research aims and have high data quality (3 stars), suggesting they are well designed and closely related to the research aims and objectives. There is no doubt to use these five questions in further data analysis.

Q9 and Q13 are strongly linked to the research aims (3 stars), but their data quality is moderate (2 stars), whereas another four questions (Q2, Q3, Q5 and Q8) are of high data quality (3 stars) but show moderate links to the research aims (2 stars). These questions are generally satisfactory and have good face validity, which can be used for further data analysis.

Although Q14 shows significant importance on the research aims (3 stars), it has a relatively poor data quality score (1 star), mainly caused by the unexpected response from participants from Shenyang city who argued whether city planners should become involved in brownfield redevelopment. In contrast, Q1 has moderate data quality (2 stars) but its link to research aims is minimal (1 star), as this question is mainly used to collect the basic information of participants and most of participants thought it is not relevant to the research topics. As for Q4, which has both moderate links to research aims (2 stars) and data quality (2 stars), nearly half of the participants thought it is similar to Q3, as they did not recognize the difference in land use/planning and city planning.

Overall, 11 out of 14 questions (Q2 to Q13) in questionnaire show both satisfactory data quality and strong link to research aims, and their scores should be included in further data analysis. Q1 can be only used as background information to distinguish the place and position of participants to categorize them into different groups for statistical data analysis. Q14 needs to be re-evaluated in the content validity and the construct validity test and carefully analyzed before statistical data analysis. Q4 should be analyzed together with Q3, as both of them might be understood as the same question by many participants and individual analysis of each question might lead to misunderstanding of the results.

4.3.2 Content validity

Content validity test can assess whether the questions in questionnaire can fully cover the research topics, represented by the number of questions answered by participants and the percentage of with satisfactory face validity in each question groups.

Twenty-two of the total thirty-three questions were answered by all the participants,

showing that they are well designed and all the participants can give appropriate response. One city planner in Guangzhou did not answer Q7.1 and Q7.2, because the participant was a new staff member in the department and was not aware of the practical decision-making process for either city planning and brownfield redevelopment. One brownfield redeveloper in Shenyang did not answer Q9, as the participant was never involved in any city planning projects; another city planner in Shenyang did not answer Q10, because this participant had not been involved in any projects related to brownfield redevelopment and had no idea about brownfield information.

Seven city planners from Shenyang did not answer Q2. From the direct contact with them, they were not actually familiar with city planning or did not participant in any city planning project. Seven city planners from Guangzhou did not answer Q6, because they did not think brownfield redevelopment is linked with city planning and it is not necessary to consider brownfield redevelopment in the city planning process. These results suggest that the coherent links between city planning and brownfield redevelopment are not well recognized by all city planners or brownfield redevelopers in China. There should be some additional notes supplemented with Q2 and Q6 for participants to understanding more clearly the relationship between city planning and brownfield redevelopment.

For Q1 to Q6 which were aimed to identify the purposes of city planning and the importance of driving forces, only Q1 did not have satisfactory data quality and all the other questions had a high score for face validity. Accordingly, most of the questions in this group can be used to answer the research questions about the different driving forces on city planning and brownfield redevelopment, respectively.

All the questions in group of Q7 to Q12 have satisfactory scores of face validity, which attempt to reveal the current and ideal situation of driven forces on brownfield redevelopment and involvement of decision-making for city planning in brownfield development processes from different perspectives. Thus, all the participants thought this part of questionnaire was well designed and covered the main research aims.

The third group of questions contain only Q13 and Q14, and among them, Q14 does not have acceptable scores of face validity. This question group was therefore not appropriately planned, and all the analysis on the ideal involvement of city planners in decision-making for brownfield redevelopment should be carefully analysed together with qualitative analysis on interviews.

4.3.3 Construct validity

Whether the general results of this questionnaire can fit with hypothesis 1, construct validity is considered in this project by collecting feedback from participants on whether the questions in the questionnaire can properly reflect the challenges in brownfield redevelopment. To achieve that, the variance of answer selection for each question is calculated following Equation (3) to evaluate the degree of concentration option selection in each question (Lerner et al., 2001).

$$Variance_i = \frac{SD(Q_i)}{mean(Q_i)} \quad (2)$$

Here, the variance of the ith question ($Variance_i$) is the ratio of $SD(Q_i)$ (standard deviation of option selection of Q_i) to $mean(Q_i)$ (the average option selection of Q_i).

Table 4.2 Summary of answer rate and predominant selection of each question.

Question number	Answered by participants	Rate of answer	Answers with highest possibility	Variance in answer selection	Predominant selection
1.1	197	100%	1	0.46	1 and 2. Priority and neutral
1.2	197	100%	2	0.55	2. Neutral
1.3	197	100%	1	0.47	1 and 2. Priority and neutral
1.4	197	100%	1	0.51	1 and 2. Priority and neutral
1.5	197	100%	1	0.55	1 and 2. Priority and neutral
2	189	96%	2	0.71	B. Local economic development
3.1	197	100%	4	1.17	3 and 4. Neutral and more important
3.2	197	100%	4	1.16	4. More important
3.3	197	100%	4	1.23	4. More important
4.1	197	100%	4	1.20	4. More important
4.2	197	100%	4	1.21	4. More important
4.3	197	100%	4	1.23	4. More important
5.1	197	100%	3	1.23	3 and 4. Neutral and more important
5.2	197	100%	4	1.14	4. More important
5.3	197	100%	4	1.24	4. More important
6.1	190	96%	3	1.23	4. More important
6.2	190	96%	3	1.20	4. More important
7.1	196	99%	4	1.12	4. To some extent
7.2	196	99%	4	1.18	3 and 4. Limited and to some extent
8.1	197	100%	2	0.74	B. Consider a little
8.2	197	100%	2	0.73	
9	196	99%	3	0.97	4. More important
10.1	196	99%	2	0.70	B. Limited
10.2	196	99%	2	0.74	B. Limited
10.3	196	99%	2	0.73	B. Limited
10.4	196	99%	2	0.74	B and C. Limited or to some extent
11	197	100%	3	1.07	B and C. Limited role or some important role
12	197	100%	3	0.64	C. Well negotiation
13.1	197	100%	4	0.99	
13.2	197	100%	4	1.02	
13.3	197	100%	4	1.01	
14.1	197	100%	4	0.98	
14.2	197	100%	4	0.95	
14.3	197	100%	4	1.01	

Q1, Q2, Q8, Q10 and Q12 have the variance of option selection significantly less than 1.0, showing that all the participants have similar choices. Q9, Q11, Q13 and Q14 have the variance of option selection close to 1.0, suggesting the choices of all participants fall within 1 to 2 choices. For all the other questions (Q3, Q4, Q5 and Q6), the variance of option selection is significantly higher than 1.0 and indicates diverse selection was made by the participants. In brief, these results suggested that the driving forces for city planning (Q3) and brownfield redevelopment (Q4) and the involvement of brownfield redevelopers and members from third parties in the decision-making process for city planning (Q5 and Q6) are not within agreement among all the participants.

For the first group of questions, which mainly target city planning process, most city planners have no idea about its roles in brownfield development, and occasionally asked the reason for putting questions Q3, Q4, Q5 and Q6. Thus, the difference in their understanding of links between city planning and brownfield redevelopment might affect their choice, leading to relatively higher variance of option selection.

For the rest of the questions in the second and third group of questions (Q7 to Q14), the variance of option selection suggests only one or two options are selected, indicating that the questions are well designed to test our hypothesis and appropriate options in each question can be used to test our hypothesis and obtain accurate results.

In summary, the construct validity of the formal questionnaire is satisfactory, that mainly one to two options in each question were selected by participants, the scores are valid for further statistical analysis.

4.4 Summary of qualitative interview

In total, 21 interviews were of high quality with clear answers and long interview duration (3 over 30 minutes and 18 for 15-30 minutes). As these interviews covered most of the interview questions with satisfactory and comprehensive discussion, they were of high quality and fully translated from Chinese into English (details see supplementary materials) for interpretation.

Other interviews lasted less than 15 minutes (8 for 10-15 minutes, 23 for 5-10 minutes and 14 for less than 5 minutes) and were carefully re-evaluated for their quality. Because those answering only 1 to 2 questions were attributed to insufficient negotiation with interviewers and might not be able to accurately reflect the real situation about city planning and brownfield, they were only stored and not included in further qualitative analysis, except for those answers had valuable information or provided specific points

of view. As for other interviews of high quality, they were handled similarly to these long interviews for comprehensive analysis.

5. Results of quantitative questionnaire

In this chapter, the results of the quantitative questionnaire are presented and discussed. Initially, responses to the individual questions are presented and summarized. The data from these questions are analyzed and discussed to: assess differences in responses between the cities and between the stakeholder groups; explore the driving forces on participants' opinions, particularly over links between city planning and brownfield redevelopment. Links between the questionnaire responses and the thesis research hypotheses (see Chapter 3) are also considered. There is a discussion of how brownfield redevelopment is considered in the decision-making process for city planning.

5.1 Responses to individual questions

5.1.1 Question 1 'What is the main purpose of city planning in your city?'

Participants could select from the following options: '*to improve economic development*' (Answer 1.1), '*to improve urbanization level*' (A1.2), '*to improve infrastructure construction*' (A1.3), '*to improve city sustainability*' (A1.4), and '*to improve urban environment*' (A1.5). They could give three options – '*priority*', '*neutral*' and '*less priority*'.

Table 5.1 Number and percentage of options selected by participants for Question 1.

Options	Priority		Neutral		Less priority	
Answers	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants						
1.1	**138**	**70.1%**	59	29.9%	0	0.0%
1.2	74	37.6%	**115**	**58.4%**	8	4.1%
1.3	**141**	**71.6%**	55	27.9%	1	0.5%
1.4	**148**	**75.1%**	43	21.8%	6	3.0%
1.5	**130**	**66.0%**	60	30.5%	7	3.6%
Shenyang city						
1.1	**41**	**75.9%**	13	24.1%	0	0.0%
1.2	22	40.7%	**30**	**55.6%**	2	3.7%
1.3	**41**	**75.9%**	13	24.1%	0	0.0%
1.4	**39**	**72.2%**	15	27.8%	0	0.0%
1.5	**36**	**66.7%**	17	31.5%	1	1.9%
Guangzhou city						
1.1	**40**	**72.7%**	15	27.3%	0	0.0%
1.2	25	45.5%	**29**	**52.7%**	1	1.8%
1.3	**36**	**65.5%**	19	34.5%	0	0.0%
1.4	**44**	**80.0%**	8	14.5%	3	5.5%
1.5	**30**	**54.5%**	21	38.2%	4	7.3%
Wuhan city						
1.1	**57**	**64.8%**	31	35.2%	0	0.0%
1.2	27	30.7%	**56**	**63.6%**	5	5.7%
1.3	**64**	**72.7%**	23	26.1%	1	1.1%
1.4	**65**	**73.9%**	20	22.7%	3	3.4%
1.5	**64**	**72.7%**	22	25.0%	2	2.3%
City planners						
1.1	**43**	**68.3%**	20	31.7%	0	0.0%
1.2	25	39.7%	**35**	**55.6%**	3	4.8%
1.3	**43**	**68.3%**	19	30.2%	1	1.6%
1.4	**49**	**77.8%**	12	19.0%	2	3.2%
1.5	**41**	**65.1%**	21	33.3%	1	1.6%
Brownfield redevelopers						
1.1	**48**	**65.8%**	25	34.2%	0	0.0%
1.2	19	26.0%	**53**	**72.6%**	1	1.4%
1.3	**49**	**67.1%**	24	32.9%	0	0.0%
1.4	**50**	**68.5%**	21	28.8%	2	2.7%
1.5	**47**	**64.4%**	24	32.9%	2	2.7%
Members from third party						
1.1	**47**	**77.0%**	14	23.0%	0	0.0%
1.2	**30**	**49.2%**	27	44.3%	4	6.6%
1.3	**49**	**80.3%**	12	19.7%	0	0.0%
1.4	**49**	**80.3%**	10	16.4%	2	3.3%
1.5	**42**	**68.9%**	15	24.6%	4	6.6%

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

All participants selected '*to improve city sustainability*' (A1.4) as the most important purpose, with 75.1% of participants saying it is '*priority*' (Table 5.1).

The options '*to improve infrastructure construction*' (A1.3), '*to improve economic development*' (A1.1) and '*to improve urban environment*' (A1.5) were also chosen as important purposes of city planning, with 71.6%, 70.1% and 66.0% of participants saying these are also 'priority'. '*To improve urbanization level*' (A1.2) was deemed less important, with the majority of participants (58.4%) selecting the 'neutral' option.

Participants from different cities hold slightly different opinions towards the main purpose of city planning. *'To improve economic development*" (A1.1) and '*to improve infrastructure construction*' (A1.3) are more important in Shenyang, where both were selected by 75.9% of the participants. In Guangzhou, 80% of participants selected '*to improve city sustainability*' (A1.4) is as the important purpose for city planning, whereas '*to improve infrastructure construction*' (A1.3), '*to improve city sustainability*' (A1.4), and '*to improve urban environment*' (A1.5) are similarly selected by participants (70-80%) as the most important purpose.

Participants from different stakeholder groups have significantly different opinions towards the main purpose of city planning. Most city planners (55.6%) and brownfield redevelopers (72.6%) think '*to improve urbanization level*' (A1.2) is less important compared to other two groups, whereas members from third parties hold the opposite opinion (49.2%) that '*to improve urbanization level*' (A1.2) is still an important purpose, although its importance was weaker than other purposes.

5.1.2 Question 2 'Which of the following factors is the key driving force affecting decision making for city planning?'

Participants could select from the following three options: '*central government or national plan*', '*local economic development*' and '*local sustainable development*'.

Table 5.2 Number and percentage of options selected by participants for Question 2.

Options	Central government or national plan		Local economic development		Local sustainable development	
All participants						
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants	35	18.5%	**91**	**48.1%**	63	33.3%
Participants from different cities						
Shenyang	9	19.6%	**26**	**56.5%**	11	23.9%
Wuhan	13	23.6%	**26**	**47.3%**	16	29.1%
Guangzhou	13	14.8%	**39**	**44.3%**	36	40.9%
Participants from different stakeholder groups						
City planners	15	27.3%	**27**	**49.1%**	13	23.6%
Brownfield redevelopers	10	13.7%	**34**	**46.6%**	29	39.7%
Members from third party	10	16.4%	**30**	**49.2%**	21	34.4%

Note: Bold number refers to the option selected by most participants. Grey cell represents the options selected by over 20% of participants.

For all participants, '*local economic development*' was the most important driving force affecting the decision-making process for city planning (41.8%), followed by '*local sustainable development*' (33.3%) and '*central government or national plan*' (18.5%).

There was no significant difference in driving forces selected by the participants from the three cities or three groups of stakeholders.

Participants from each city or each stakeholder group agreed that '*local economic development*' is the most important driving force affecting the decision-making process for city planning. The only exception is that city planners think that the '*central government or national plan*' (27.3%) is more important than '*local sustainable development*' (23.6%).

5.1.3 Question 3 'What is the importance of the following driving forces on land use and planning?'

The three given driving forces are '*central government or national plan*' (A3.1), '*local economic development*' (A3.2) and '*local sustainable development*' (A3.3). The options are numbered from 1 to 5, and the importance increases from 1 to 5.

Table 5.3 Number and percentage of options selected by participants for Question 3.

Options	Least important		Less important		Neutral		More important		Most important	
All participants										
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
3.1	12	6.1%	22	11.2%	48	24.4%	**62**	**31.5%**	53	26.9%
3.2	10	5.1%	15	7.6%	30	15.2%	58	29.4%	**84**	**42.6%**
3.3	18	9.1%	7	3.6%	41	20.8%	58	29.4%	**73**	**37.1%**
Shenyang city										
3.1	3	5.6%	7	13.0%	**17**	**31.5%**	16	29.6%	11	20.4%
3.2	2	3.7%	8	14.8%	9	16.7%	10	18.5%	**25**	**46.3%**
3.3	3	5.6%	3	5.6%	16	29.6%	15	27.8%	**17**	**31.5%**
Guangzhou city										
3.1	1	1.8%	3	5.5%	8	14.5%	**25**	**45.5%**	18	32.7%
3.2	0	0.0%	2	3.6%	5	9.1%	20	36.4%	**28**	**50.9%**
3.3	2	3.6%	1	1.8%	8	14.5%	22	40.0%	**22**	**40.0%**
Wuhan city										
3.1	8	9.1%	12	13.6%	23	26.1%	21	23.9%	**24**	**27.3%**
3.2	8	9.1%	5	5.7%	16	18.2%	28	31.8%	**31**	**35.2%**
3.3	13	14.8%	3	3.4%	17	19.3%	21	23.9%	**34**	**38.6%**
City planners										
3.1	4	6.3%	7	11.1%	18	28.6%	14	22.2%	**20**	**31.7%**
3.2	1	1.6%	11	17.5%	10	15.9%	18	28.6%	**23**	**36.5%**
3.3	4	6.3%	3	4.8%	16	25.4%	17	27.0%	**23**	**36.5%**
Brownfield redevelopers										
3.1	7	9.6%	10	13.7%	15	20.5%	**24**	**32.9%**	17	23.3%
3.2	9	12.3%	4	5.5%	12	16.4%	20	27.4%	**28**	**38.4%**
3.3	12	16.4%	4	5.5%	15	20.5%	17	23.3%	**25**	**34.2%**
Members from third party										
3.1	1	1.6%	5	8.2%	15	24.6%	**24**	**39.3%**	16	26.2%
3.2	0	0.0%	0	0.0%	8	13.1%	20	32.8%	**33**	**54.1%**
3.3	2	3.3%	0	0.0%	10	16.4%	24	39.3%	**25**	**41.0%**

Note: Bold number refers to the option selected by most participants. Grey cell represents the options selected by over 20% of participants.

For all participants, '*local economic development*' is viewed as the most important driving force with 42.6% or 29.4% of participants thinking it is most or more important (Table 5.3). *'Local sustainable development*' ranked as the second most important driving force and the percentage of participants that chose it as the most and more important options was 37.1% and 29.4%, respectively. 'C*entral government or national plan*' is the least important driving force; nearly equal participants think its importance is neutral, more or most.

For participants from different cities, those from Wuhan city showed a significantly different behavior. They gave these three main driving forces similar importance. The percentage selecting '*central government or national plan*', '*local economic development*' and '*local sustainable development*' as the most important driving force was 27.3, 35.2 and 38.6%, respectively. Participants from Shenyang and Guangzhou city had similar opinions to each other.

For participants from different stakeholder groups, brownfield redevelopers and members from third parties held similar views towards the importance of the three driving forces. All participants believed that '*local economic development*' and '*local sustainable development*' are more important than '*central government or national plan*'. However, city planners believed that '*local economic development*', '*local sustainable development*' and '*central government or national plan*' had equal importance (37%, 36.5% and 36.5%, respectively).

5.1.4 Question 4 'How does the following driving force affect decision making for city planning? (1 for least important and 5 for most important)"

The three given driving forces are '*central government or national plan*' (A4.1), '*local economic development*' (A4.2) and '*local sustainable development*' (A4.3). The options are numbered from 1 to 5, with importance increasing from 1 to 5.

Table 5.4 Number and percentage of options selected by participants for Question 4.

Options	Least important		Less important		Neutral		More important		Most important	
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants										
A4.1	14	7.1%	14	7.1%	45	22.8%	56	28.4%	**68**	**34.5%**
A4.2	13	6.6%	15	7.6%	33	16.8%	57	28.9%	**79**	**40.1%**
A4.3	17	8.6%	11	5.6%	42	21.3%	58	29.4%	**69**	**35.0%**
Shenyang city										
A4.1	4	7.4%	3	5.6%	16	29.6%	14	25.9%	**17**	**31.5%**
A4.2	2	3.7%	6	11.1%	14	25.9%	14	25.9%	**18**	**33.3%**
A4.3	5	9.3%	6	11.1%	10	18.5%	**18**	**33.3%**	15	27.8%
Guangzhou city										
A4.1	2	3.6%	1	1.8%	11	20.0%	18	32.7%	**23**	**41.8%**
A4.2	0	0.0%	1	1.8%	6	10.9%	21	38.2%	**27**	**49.1%**
A4.3	0	0.0%	2	3.6%	12	21.8%	20	36.4%	**21**	**38.2%**
Wuhan city										
A4.1	8	9.1%	10	11.4%	18	20.5%	24	27.3%	**28**	**31.8%**
A4.2	11	12.5%	8	9.1%	13	14.8%	22	25.0%	**34**	**38.6%**
A4.3	12	13.6%	3	3.4%	20	22.7%	20	22.7%	**33**	**37.5%**
City planners										
A4.1	3	4.8%	4	6.3%	**19**	**30.2%**	14	22.2%	**23**	**36.5%**
A4.2	2	3.2%	10	15.9%	12	19.0%	12	19.0%	**27**	**42.9%**
A4.3	6	9.5%	7	11.1%	12	19.0%	**19**	**30.2%**	**19**	**30.2%**
Brownfield redevelopers										
A4.1	7	9.6%	8	11.0%	14	19.2%	**24**	**32.9%**	20	27.4%
A4.2	9	12.3%	4	5.5%	13	17.8%	19	26.0%	**28**	**38.4%**
A4.3	10	13.7%	4	5.5%	18	24.7%	**20**	**27.4%**	**21**	**28.8%**
Members from third party										
A4.1	4	6.6%	2	3.3%	12	19.7%	18	29.5%	**25**	**41.0%**
A4.2	2	3.3%	1	1.6%	8	13.1%	**26**	**42.6%**	24	39.3%
A4.3	1	1.6%	0	0.0%	12	19.7%	19	31.1%	**29**	**47.5%**

Note: Bold refers to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

For all participants, '*local economic development*' is viewed as the most important driving force (Table 5.4).*'Local sustainable development*' and '*central government or national plan*' are of similar importance to each other (34.5% and 28.4% of all participants think "*central government or national plan*" is most and more important, respectively.

Participants from Wuhan and Guangzhou have similar opinions towards the importance of the three driving forces, ranking '*local economic development*' > '*central government*

or national plan' = '*local sustainable development*'. Participants from Shenyang think '*central government or national plan*' (31.5% most important) and '*local economic development*' (33.3% most important) are of similar importance, both significantly more important than '*local sustainable development*' (33.3% more important).

For participants from different stakeholder groups, diverse results are obtained. Both city planners and brownfield re-developers think '*local economic development*' is the most important driving force (42.9% and 38.4% for most importance respectively). However, city planners regard '*central government or national plan*' as the second important driving force, whereas brownfield redevelopers view '*local sustainable development*' as the second important driving force. Members from third parties think '*local sustainable development*' (47.5% most important) is the most important driving force, followed by '*central government or national plan*' (41.0% most important) and "*local economic development*" (39.3% most important).

5.1.5 Question 5 "How do the following driving forces affect the brownfield redevelopment? (1 for least important and 5 for most important)"

The three driving forces offered are '*central government or national plan*' (A5.1), '*local economic development*' (A5.2) and '*local sustainable development*' (A5.3). The options are numbered from 1 to 5, and the importance increases from 1 to 5.

Table 5.5 Number and percentage of options selected by participants for Question 5.

Options	Least important		Less important		Neutral		More important		Most important	
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants										
A5.1	18	9.1%	27	13.7%	**58**	**29.4%**	49	24.9%	45	22.8%
A5.2	11	5.6%	13	6.6%	48	24.4%	61	31.0%	**64**	**32.5%**
A5.3	14	7.1%	13	6.6%	41	20.8%	44	22.3%	**85**	**43.1%**
Shenyang city										
A5.1	4	7.4%	6	11.1%	**23**	**42.6%**	9	16.7%	12	22.2%
A5.2	1	1.9%	6	11.1%	**18**	**33.3%**	15	27.8%	14	25.9%
A5.3	4	7.4%	7	13.0%	10	18.5%	11	20.4%	**22**	**40.7%**
Guangzhou city										
A5.1	4	7.3%	4	7.3%	14	25.5%	14	25.5%	**19**	**34.5%**
A5.2	1	1.8%	2	3.6%	7	12.7%	18	32.7%	**27**	**49.1%**
A5.3	1	1.8%	3	5.5%	10	18.2%	12	21.8%	**29**	**52.7%**
Wuhan city										
A5.1	10	11.4%	17	19.3%	21	23.9%	**26**	**29.5%**	14	15.9%
A5.2	9	10.2%	5	5.7%	23	26.1%	**28**	**31.8%**	23	26.1%
A5.3	9	10.2%	3	3.4%	21	23.9%	21	23.9%	**34**	**38.6%**
City planners										
A5.1	4	6.3%	13	20.6%	**16**	**25.4%**	13	20.6%	**17**	**27.0%**
A5.2	2	3.2%	8	12.7%	**18**	**28.6%**	16	25.4%	**19**	**30.2%**
A5.3	4	6.3%	6	9.5%	8	12.7%	16	25.4%	**29**	**46.0%**
Brownfield redevelopers										
A5.1	10	13.7%	9	12.3%	20	27.4%	**24**	**32.9%**	10	13.7%
A5.2	8	11.0%	3	4.1%	16	21.9%	22	30.1%	**24**	**32.9%**
A5.3	9	12.3%	4	5.5%	19	26.0%	15	20.5%	**26**	**35.6%**
Members from third party										
A5.1	4	6.6%	5	8.2%	**22**	**36.1%**	12	19.7%	18	29.5%
A5.2	1	1.6%	2	3.3%	14	23.0%	**23**	**37.7%**	21	34.4%
A5.3	1	1.6%	3	4.9%	14	23.0%	13	21.3%	**30**	**49.2%**

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

In the summary data for all participants '*local sustainable development*' and '*local economic development*' were deemed most important, more important than the national level actions.

Of the city planners, those from Guangzhou thought '*central government or national plan*' is the most important factor affecting brownfield redevelopment. Brownfield redevelopers from Shenyang and city planners from Wuhan city believed the opposite. Participants from Guangzhou took '*local economic development*' as the most important

driving force.

Although city planners from Shenyang city thought '*local economic development*' is the least important for brownfield redevelopment, members from third parties believed it is more important than other options. City planners from Guangzhou thought '*local sustainable development*' is of most importance, whereas city planners from Shenyang were opposite. Both members from third party in Wuhan and Shenyang took '*local sustainable development*' as the most important driving force for brownfield redevelopment.

5.1.6 Question 6 'Are brownfield redevelopers and third parties currently involved in decision making for city planning?'

The two given participant groups are "*brownfield redevelopers*" (A6.1) and "*members from third party*" (A6.2). The options are numbers from 1 to 5, and the importance increases from 1 to 5.

Table 5.6 Number and percentage of options selected by participants for Question 6.

Options	Least involvement		Less involvement		Neutral		More involvement		Most involvement	
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants										
A6.1	25	13.2%	42	22.1%	**59**	**31.1%**	38	20.0%	26	13.7%
A6.2	36	18.9%	43	22.6%	**62**	**32.6%**	33	17.4%	16	8.4%
Shenyang city										
A6.1	5	9.3%	6	11.1%	**29**	**53.7%**	10	18.5%	4	7.4%
A6.2	8	14.8%	**20**	**37.0%**	10	18.5%	11	20.4%	5	9.3%
Guangzhou city										
A6.1	8	16.7%	**17**	**35.4%**	8	16.7%	10	20.8%	5	10.4%
A6.2	11	22.9%	10	20.8%	**20**	**41.7%**	5	10.4%	2	4.2%
Wuhan city										
A6.1	12	13.6%	19	21.6%	**22**	**25.0%**	18	20.5%	17	19.3%
A6.2	17	19.3%	13	14.8%	**32**	**36.4%**	17	19.3%	9	10.2%
City planners										
A6.1	7	12.5%	15	26.8%	**17**	**30.4%**	10	17.9%	7	12.5%
A6.2	11	19.6%	11	19.6%	**21**	**37.5%**	10	17.9%	3	5.4%
Brownfield redevelopers										
A6.1	10	13.7%	12	16.4%	**25**	**34.2%**	15	20.5%	11	15.1%
A6.2	17	23.3%	13	17.8%	**21**	**28.8%**	12	16.4%	10	13.7%
Members from third party										
A6.1	8	13.1%	15	24.6%	**17**	**27.9%**	13	21.3%	8	13.1%
A6.2	8	13.1%	**19**	**31.1%**	**20**	**32.8%**	11	18.0%	3	4.9%

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

The results of Question 6 suggest that the current involvement of both brownfield redevelopers and members from third parties is limited in the decision-making process for city planning in China. Brownfield redevelopers are slightly more involved than third party members.

5.1.7 Question 7 'In a well-established and proper city planning process, should brownfield redevelopers and third parties be involved in decision making for city planning? (1 for least involvement and 5 for most involvement)"

The two given participant groups are '*brownfield redevelopers*' (A7.1) and '*members from third party*' (A7.2). The options are numbers from 1 to 5, and the importance increases from 1 to 5.

Table 5.7 Number and percentage of options selected by participants for Question 7.

Options	Least involvement		Less involvement		Neutral		More involvement		Most involvement	
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants										
A7.1	9	4.6%	12	6.1%	35	17.9%	60	30.6%	**80**	**40.8%**
A7.2	14	7.1%	14	7.1%	41	20.9%	**66**	**33.7%**	61	31.1%
Shenyang city										
A7.1	0	0.0%	5	9.3%	12	22.2%	18	**33.3%**	**19**	**35.2%**
A7.2	3	5.6%	7	13.0%	13	24.1%	12	22.2%	**19**	**35.2%**
Guangzhou city										
A7.1	1	1.9%	1	1.9%	7	13.0%	21	38.9%	**24**	**44.4%**
A7.2	2	3.7%	1	1.9%	6	11.1%	**28**	**51.9%**	17	31.5%
Wuhan city										
A7.1	8	9.1%	6	6.8%	16	18.2%	21	23.9%	**37**	**42.0%**
A7.2	9	10.2%	6	6.8%	22	25.0%	**26**	**29.5%**	**25**	**28.4%**
City planners										
A7.1	2	3.2%	7	11.3%	13	21.0%	15	24.2%	**25**	**40.3%**
A7.2	6	9.7%	6	9.7%	11	17.7%	**20**	**32.3%**	**19**	**30.6%**
Brownfield redevelopers										
A7.1	5	6.8%	2	2.7%	14	19.2%	24	32.9%	**28**	**38.4%**
A7.2	8	11.0%	6	8.2%	18	24.7%	**23**	**31.5%**	18	24.7%
Members from third party										
A7.1	2	3.3%	3	4.9%	8	13.1%	21	34.4%	**27**	**44.3%**
A7.2	0	0.0%	2	3.3%	12	19.7%	**23**	**37.7%**	**24**	**39.3%**

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

In answer to this question, while the majority of participants indicate that they think more involvement is desirable, several participants judged that the involvement of brownfield redevelopers in decision-making for city planning is not important or its current situation does not require further change.

5.1.8 Question 8 'Are you aware of the decision-making process for city planning and brownfield redevelopment?'

The two given decision-making processes are related to '*city planning*' (A8.1) and '*brownfield redevelopment*' (A8.2). Five options representing different levels of awareness were provided, ranging from '*no awareness'* to *'excellent awareness*'.

Table 5.8 Number and percentage of options selected by participants for Question 8.

Options	No awareness		Limited awareness		Some awareness		Good awareness		Excellent awareness	
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants										
Q8.1	35	17.8%	**119**	**60.4%**	33	16.8%	10	5.1%	0	0.0%
Q8.2	36	18.3%	**119**	**60.4%**	33	16.8%	9	4.6%	0	0.0%
Shenyang city										
Q8.1	8	14.8%	**35**	**64.8%**	6	11.1%	5	9.3%	0	0.0%
Q8.2	7	13.0%	**38**	**70.4%**	7	13.0%	2	3.7%	0	0.0%
Guangzhou city										
Q8.1	7	12.7%	**39**	**70.9%**	9	16.4%	0	0.0%	0	0.0%
Q8.2	12	21.8%	**36**	**65.5%**	4	7.3%	3	5.5%	0	0.0%
Wuhan city										
Q8.1	20	22.7%	**45**	**51.1%**	18	20.5%	5	5.7%	0	0.0%
Q8.2	17	19.3%	**45**	**51.1%**	22	25.0%	4	4.5%	0	0.0%
City planners										
Q8.1	3	4.8%	**41**	**65.1%**	15	23.8%	4	6.3%	0	0.0%
Q8.2	17	27.0%	**41**	**65.1%**	4	6.3%	1	1.6%	0	0.0%
Brownfield redevelopers										
Q8.1	19	26.0%	**40**	**54.8%**	12	16.4%	2	2.7%	0	0.0%
Q8.2	13	17.8%	**38**	**52.1%**	17	23.3%	5	6.8%	0	0.0%
Members from third party										
Q8.1	13	21.3%	**38**	**62.3%**	6	9.8%	4	6.6%	0	0.0%
Q8.2	6	9.8%	**40**	**65.6%**	12	19.7%	3	4.9%	0	0.0%

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

Interestingly, no participants selected *'excellent awareness'* and only a handful selected *'good awareness'*. Most selected *'limited awareness'*. City planners were the least familiar with the decision-making process for brownfield redevelopment in all the three cities, suggesting their limited consideration of brownfield redevelopment in city planning or they are not much involved in brownfield redevelopment process.

5.1.9 Question 9 'How does a city planner consider brownfield redevelopment in decision making for city planning?'

The four options are '*no consideration*', '*limited consideration*' (only mark the brownfield site for further redevelopment, but the site function and land use are only based on the purpose of city planning), '*some consideration*' (city planner will use site information and design its function or land use, with appropriate evaluation of remediation target, remediation cost or remediation time, and this information is

combined with city planning purpose to make the most appropriate decision), and '*good consideration*' (city planner will collect full information of the brownfield, discussion comprehensively with brownfield redeveloper and land user to well design the remediation target, cost and time, and after choosing the most appropriate alternative, consider it together with city planning purpose and make the best decision).

Table 5.9 Number and percentage of options selected by participants for Question 9.

Options	No consideration		Limited consideration		Some consideration		Good consideration	
	No.	%	No.	%	No.	%	No.	%
All participants	15	7.7%	42	21.4%	56	28.6%	**83**	**42.3%**
Participants from different cities								
Shenyang	5	9.4%	6	11.3%	10	18.9%	**32**	**60.4%**
Wuhan	3	5.5%	16	29.1%	15	27.3%	**21**	**38.2%**
Guangzhou	7	8.0%	20	22.7%	**31**	**35.2%**	**30**	**34.1%**
Participants from different stakeholder groups								
City planners	3	4.8%	14	22.2%	17	27.0%	**29**	**46.0%**
Brownfield redevelopers	7	9.7%	14	19.4%	**25**	**34.7%**	**26**	**36.1%**
Members from third party	5	8.2%	14	23.0%	14	23.0%	**28**	**45.9%**

Note: Bold number refers to the option selected by most participants. Grey cell represents the options selected by over 20% of participants.

This question generated some interesting data. Across all participants, *'good consideration'* was the most popular answer, but the majority of participants did not choose this answer – preferring *'limited'* or *'some consideration'*.

There were differences in the responses between cities; city planners from Shenyang suggested that decision-making for city planning should *'fully consider'* brownfield redevelopment, while *'some consideration'* was the most popular choice in Guangzhou. Shenyang has a history of industrial contamination and recent mega projects of brownfield redevelopment. All the other participants had similar idea that moderate consideration of brownfield redevelopment should be carried out in decision-making for city planning.

5.1.10 Question 10 'Are you aware of the following issues related to brownfield redevelopment?'

The four issues given are '*current situation of land use*' (A10.1), '*contamination level of land use*' (A10.2), '*number and location of brownfield*' (A10.3), to '*contamination level of brownfield*' (A10.4). Four options representing different levels of awareness were offered, namely '*completely unclear*', '*limited*', '*to some extent*', and '*completely clear*.

Most responses indicated participants believed they have only a *'limited'* awareness of the issues raised by the question.

Respondents felt they were more aware of the '*current situation of land use*' and '*contamination level of land use*' than '*number and location of brownfields*' and '*contamination level of brownfield*'. This suggests that many are getting information about brownfield redevelopment, but there is a perceived lack of a database describing the details of brownfields which restricts their further awareness.

Re-developers from Shenyang and Wuhan were more aware of the information/its availability than those from Guangzhou and members from third parties in Wuhan had more awareness than those in the same participant group from the other two cities.

Table 5.10 Number and percentage of options selected by participants for Question 10.

Options	Completely unclear		Limited		To some extent		Completely clear	
	No.	%	No.	%	No.	%	No.	%
All participants								
A10.1	35	17.9%	**118**	**60.2%**	37	18.9%	6	3.1%
A10.2	49	25.0%	**107**	**54.6%**	34	17.3%	6	3.1%
A10.3	65	33.2%	**100**	**51.0%**	27	13.8%	4	2.0%
A10.4	**84**	**42.9%**	**88**	**44.9%**	19	9.7%	5	2.6%
Shenyang								
A10.1	10	18.9%	**33**	**62.3%**	8	15.1%	2	3.8%
A10.2	9	17.0%	**33**	**62.3%**	10	18.9%	1	1.9%
A10.3	18	34.0%	**27**	**50.9%**	7	13.2%	1	1.9%
A10.4	20	37.7%	**26**	**49.1%**	7	13.2%	0	0.0%
Wuhan								
A10.1	10	18.2%	**32**	**58.2%**	13	23.6%	0	0.0%
A10.2	14	25.5%	**33**	**60.0%**	8	14.5%	0	0.0%
A10.3	20	36.4%	**28**	**50.9%**	7	12.7%	0	0.0%
A10.4	**29**	**52.7%**	21	38.2%	3	5.5%	2	3.6%
Guangzhou								
A10.1	15	17.0%	**53**	**60.2%**	16	18.2%	4	4.5%
A10.2	26	29.5%	**41**	**46.6%**	16	18.2%	5	5.7%
A10.3	27	30.7%	**45**	**51.1%**	13	14.8%	3	3.4%
A10.4	35	39.8%	**41**	**46.6%**	9	10.2%	3	3.4%
City planner								
A10.1	9	14.5%	**38**	**61.3%**	13	21.0%	2	3.2%
A10.2	17	27.4%	**38**	**61.3%**	6	9.7%	1	1.6%
A10.3	**28**	**45.2%**	**29**	**46.8%**	4	6.5%	1	1.6%
A10.4	**37**	**59.7%**	20	32.3%	3	4.8%	2	3.2%
Brownfield redeveloper								
A10.1	18	24.7%	**44**	**60.3%**	9	12.3%	2	2.7%
A10.2	21	28.8%	**37**	**50.7%**	11	15.1%	4	5.5%
A10.3	19	26.0%	**41**	**56.2%**	11	15.1%	2	2.7%
A10.4	26	35.6%	**36**	**49.3%**	10	13.7%	1	1.4%
Third party								
A10.1	8	13.1%	**36**	**59.0%**	15	24.6%	2	3.3%
A10.2	11	18.0%	**32**	**52.5%**	17	27.9%	1	1.6%
A10.3	18	29.5%	**30**	**49.2%**	12	19.7%	1	1.6%
A10.4	21	34.4%	**32**	**52.5%**	6	9.8%	2	3.3%

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

5.1.11 Question 11 'What do you think about the current roles of city planners in brownfield redevelopment?'

Four options were provided: '*no direct role*' (city planners are not involved in brownfield redevelopment and all the key issues are determined by brownfield redevelopers and land users), '*limited role*' (city planners provide advice for the land use and function for brownfield redevelopment, but the key decision makers are brownfield redevelopers), '*some important*' (city planners and brownfield redevelopers work together on the land use and functions, determining remediation target, cost, strategy and other relevant issues for better decision in brownfield redevelopment), and '*most important role*' (city planners determine the land use and function in city planning, and brownfield redevelopment must follow what is required in the city plan, and add detailed strategies to achieve redevelopment target).

Table 5.11 Number and percentage of options selected by participants for Question 11.

Options	No role		Limited role		Some important role		Very important role	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants	39	19.8%	51	25.9%	**57**	**28.9%**	50	25.4%
Participants from different cities								
Shenyang	7	13.0%	12	22.2%	10	18.5%	**25**	**46.3%**
Wuhan	11	20.0%	**18**	**32.7%**	**18**	**32.7%**	8	14.5%
Guangzhou	21	23.9%	21	23.9%	**29**	**33.0%**	17	19.3%
Participants from different stakeholder groups								
City planners	10	15.9%	16	25.4%	**18**	**28.6%**	**19**	**30.2%**
Brownfield redevelopers	18	24.7%	17	23.3%	**21**	**28.8%**	17	23.3%
Members from third party	11	18.0%	**18**	**29.5%**	**18**	**29.5%**	14	23.0%

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

Participants generally had the view that moderate consideration of brownfield redevelopment should be carried out in decision-making for city planning.

Similar to Question 9, the responses to Question 11 indicate that city planners generally think their current role in brownfield redevelopment is not very significant.

Planners in Shenyang were more positive about their role than their counterparts in Wuhan and Guangzhou.

5.1.12 Question 12 'What do you think about the most appropriate roles of city planner in brownfield redevelopment?'

The four options given are: '*no involvement*' (city planners are not expert in brownfield and the land use and function should be decided by brownfield redeveloper, and city planner must take the decision of brownfield redeveloper during city planning process); '*limited advice*' (brownfield redevelopers should balance the remediation target, cost, strategy and future land use, and city planner can provide some suggestions to maximize the values of land future use, but it is only one of the key factors in brownfield redevelopment); '*well negotiation*' (both brownfield redeveloper and city planner have the same goal but doing things in different ways. The remediation target, cost, strategy and future land use should be well discussed and agreed between these two groups, and both achievability and economic-cost effectiveness should be well balanced); and '*strong power*' (brownfield redevelopment is working for city plan and it must follow the requirement of city plan, and brownfield redeveloper is only responsible for carrying out redevelopment project, but cannot decide land use and function).

Table 5.12 Number and percentage of options selected by participants for Question 12.

Options	**No involvement**		**Limited advice**		**Well negotiation**		**Strong power**	
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants	3	1.5%	15	7.6%	**117**	**59.4%**	62	31.5%
Participants from different cities								
Shenyang	0	0.0%	1	1.9%	23	42.6%	**30**	**55.6%**
Wuhan	0	0.0%	0	0.0%	**33**	**60.0%**	22	40.0%
Guangzhou	3	3.4%	14	15.9%	**61**	**69.3%**	10	11.4%
Participants from different stakeholder groups								
City planners	0	0.0%	5	7.9%	**34**	**54.0%**	24	38.1%
Brownfield redevelopers	2	2.7%	8	11.0%	**41**	**56.2%**	22	30.1%
Members from third party	1	1.6%	2	3.3%	**42**	**68.9%**	16	26.2%

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

The results for this question – which asked participants to address the **most appropriate** situation for city planners – generally envisages a strong level of negotiation and collaboration between the planners and other stakeholders. Respondents in Shenyang - the city with the most direct experience of managing brownfield re-development - also

had a preference for the city planners to have 'strong power' in ensuring brownfield developers were more restricted to only carrying out projects, with a less collaborative/negotiated position on planning.

5.1.13 Question 13 'How much should city planners, brownfield redevelopers and third parties be involved in decision making for city planning? (1 for least involvement and 5 for most involvement)'

The three participant groups are '*city planners*' (A13.1), '*brownfield redevelopers*' (A13.2), and '*members from third parties'* (A13.3). The options are numbers from 1 to 5, and the involvement of each participant group increases from 1 to 5.

The majority participants think the involvement of city planners should be stronger than brownfield redevelopers and members from third parties. The overall results suggested involvement follows a sequence of city planners > brownfield redevelopers > members from third parties. Participants are evenly split on whether third parties should have *'neutral'* (31%), *'more'* (29.9%) or *'most'* (32.5%) involvement in future decision-making processes for city planning.

Participants from the three cities hold similar opinions towards the rank of the involvement of three participant groups, but their involvement level varies significantly. Participants from Wuhan and Guangzhou think the involvement of city planners should be the highest (61.4% and 65.5% for most involvement, respectively), followed by brownfield redevelopers (54.5% and 49.1% for most involvement) and members from third party (39.8% and 21.8% for most involvement). Although participants from Shenyang have similar trends, only 44.4% of participants think city planners should be most involved, and only 37.0% of participants suggest most involvement of brownfield redevelopers.

For participants from different stakeholder groups, city planners think the involvement of city planners and brownfield redevelopers in the decision-making process for city planning are similar, and 49.2% of participants from the city planner group think they should be most involved. Both brownfield redevelopers and members from third parties view the involvement of city planners as most important (63.0% and 60.7% of participants from these two groups, respectively).

Table 5.13 Number and percentage of options selected by participants for Question 13.

Options	Least involvement		Less involvement		Neutral		More involvement		Most involvement	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants										
A13.1	4	2.0%	7	3.6%	31	15.7%	41	20.8%	**114**	**57.9%**
A13.2	3	1.5%	13	6.6%	34	17.3%	52	26.4%	**95**	**48.2%**
A13.3	5	2.5%	8	4.1%	**61**	**31.0%**	**59**	**29.9%**	**64**	**32.5%**
Shenyang city										
A13.1	0	0.0%	3	5.6%	17	31.5%	10	18.5%	**24**	**44.4%**
A13.2	0	0.0%	8	14.8%	12	22.2%	14	25.9%	**20**	**37.0%**
A13.3	1	1.9%	4	7.4%	**22**	**40.7%**	10	18.5%	17	31.5%
Guangzhou city										
A13.1	0	0.0%	0	0.0%	5	9.1%	14	25.5%	**36**	**65.5%**
A13.2	0	0.0%	1	1.8%	14	25.5%	13	23.6%	**27**	**49.1%**
A13.3	1	1.8%	0	0.0%	**23**	**41.8%**	19	34.5%	12	21.8%
Wuhan city										
A13.1	4	4.5%	4	4.5%	9	10.2%	17	19.3%	**54**	**61.4%**
A13.2	3	3.4%	4	4.5%	8	9.1%	25	28.4%	**48**	**54.5%**
A13.3	3	3.4%	4	4.5%	16	18.2%	30	34.1%	**35**	**39.8%**
City planners										
A13.1	0	0.0%	2	3.2%	14	22.2%	16	25.4%	**31**	**49.2%**
A13.2	0	0.0%	8	12.7%	9	14.3%	15	23.8%	**31**	**49.2%**
A13.3	1	1.6%	4	6.3%	**22**	**34.9%**	17	27.0%	19	30.2%
Brownfield redevelopers										
A13.1	4	5.5%	2	2.7%	5	6.8%	16	21.9%	**46**	**63.0%**
A13.2	2	2.7%	3	4.1%	11	15.1%	19	26.0%	**38**	**52.1%**
A13.3	4	5.5%	2	2.7%	17	23.3%	23	31.5%	**27**	**37.0%**
Members from third party										
A13.1	0	0.0%	3	4.9%	12	19.7%	9	14.8%	**37**	**60.7%**
A13.2	1	1.6%	2	3.3%	14	23.0%	18	29.5%	**26**	**42.6%**
A13.3	0	0.0%	2	3.3%	**22**	**36.1%**	19	31.1%	18	29.5%

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

5.1.14 Question 14 'In a well-established and proper brownfield redevelopment process, should city planners, brownfield redevelopers and third parties be involved in brownfield redevelopment? (1 for least involvement and 5 for most involvement)'

The three participant groups are '*city planners*' (A14.1), '*brownfield redevelopers*' (A14.2), and '*members from third parties'* (A14.3). The options are numbers from 1 to 5, and the involvement of each participant group increases from 1 to 5.

Table 5.14 Number and percentage of options selected by participants for Question 14.

Options	Least involvement		Less involvement		Neutral		More involvement		Most involvement	
Questions	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
All participants										
A14.1	4	2.0%	5	2.5%	39	19.8%	49	24.9%	**100**	**50.8%**
A14.2	4	2.0%	7	3.6%	19	9.6%	42	21.3%	**125**	**63.5%**
A14.3	4	2.0%	9	4.6%	42	21.3%	57	28.9%	**85**	**43.1%**
Shenyang city										
A14.1	0	0.0%	1	1.9%	14	25.9%	15	27.8%	**24**	**44.4%**
A14.2	0	0.0%	6	11.1%	8	14.8%	12	22.2%	**28**	**51.9%**
A14.3	0	0.0%	5	9.3%	12	22.2%	14	25.9%	**23**	**42.6%**
Guangzhou city										
A14.1	0	0.0%	0	0.0%	12	21.8%	14	25.5%	**29**	**52.7%**
A14.2	0	0.0%	0	0.0%	5	9.1%	12	21.8%	**38**	**69.1%**
A14.3	0	0.0%	2	3.6%	**18**	**32.7%**	**16**	**29.1%**	**19**	**34.5%**
Wuhan city										
A14.1	4	4.5%	4	4.5%	13	14.8%	20	22.7%	**47**	**53.4%**
A14.2	4	4.5%	1	1.1%	6	6.8%	18	20.5%	**59**	**67.0%**
A14.3	4	4.5%	2	2.3%	12	13.6%	27	30.7%	**43**	**48.9%**
City planners										
A14.1	0	0.0%	2	3.2%	22	34.9%	13	20.6%	**26**	**41.3%**
A14.2	0	0.0%	6	9.5%	6	9.5%	15	23.8%	**36**	**57.1%**
A14.3	0	0.0%	7	11.1%	17	27.0%	13	20.6%	**26**	**41.3%**
Brownfield redevelopers										
A14.1	4	5.5%	3	4.1%	3	4.1%	20	27.4%	**43**	**58.9%**
A14.2	3	4.1%	1	1.4%	5	6.8%	12	16.4%	**52**	**71.2%**
A14.3	4	5.5%	2	2.7%	9	12.3%	23	31.5%	**35**	**47.9%**
Members from third party										
A14.1	0	0.0%	0	0.0%	14	23.0%	16	26.2%	**31**	**50.8%**
A14.2	1	1.6%	0	0.0%	8	13.1%	15	24.6%	**37**	**60.7%**
A14.3	0	0.0%	0	0.0%	16	26.2%	21	34.4%	**24**	**39.3%**

Note: Bold numbers refer to the option selected by most participants. Grey cells represent the options selected by over 20% of participants.

For all participants, the majority of them (63.5%) believe that brownfield redevelopers should have the most involvement and only about 10% of participants think the involvement of brownfield redevelopers is minimal or less. City planners are ranked as the second group of stakeholders to be involved in brownfield redevelopment, and almost half of participants (50.8%) believe that city planners should have the most involvement. Although members from third parties are suggested by all participants to have the least involvement, still 43.1% and 28.9% of participants think their

involvement should be *the most* and *more*, respectively.

Participants from Shenyang city gave a slightly different preference from those in Guangzhou and Wuhan (see Table 5.14).

Both city planners and members from third party have similar opinions towards the involvement of all three stakeholder groups. In contrast, brownfield redevelopers think the involvement of themselves and city planners should be significantly enhanced, and 58.9% and 71.2% of brownfield redevelopers choose the most involvement for city planners and brownfield redevelopers, respectively.

5.2 Preliminary comments on some overall results of the quantitative questionnaire

Table 5.15 provides an overall summary of responses to the questionnaire.

As shown in section 5.1, for most of the questions, the majority of participants have broadly similar selections. This indicates that most of the main stakeholders in decision-making process for city planning and brownfield redevelopment have broadly common views. However, there are important differences in knowledge, understanding and views held by the participants. It is worth highlighting some of the questions which draw out differences in responses.

For Question 3.1 (What is the importance of central government or national plan on the land use and planning?), participants from different stakeholder groups chose "*more important*" (31.5%) and "*most important*" (26.9%). It seems that the roles of central government or national plan in city planning are less important than local economic development or sustainable development (e.g. comparing to Questions 3.2 and 3.3).

Table 5.1. Percentage of option selection for each question.

Questions	Option 1	Option 2	Option 3	Option 4	Option 5
Q1.1	**70.1%**	29.9%	-	-	-
Q1.2	37.6%	**58.4%**	4.1%	-	-
Q1.3	**71.6%**	27.9%	0.5%	-	-
Q1.4	**75.1%**	21.8%	3.0%	-	-
Q1.5	**66.0%**	30.5%	3.6%	-	-
Q2	18.5%	**48.1%**	33.3%	-	-
Q3.1	6.1%	11.2%	24.4%	**31.5%**	26.9%
Q3.2	5.1%	7.6%	15.2%	29.4%	**42.6%**
Q3.3	9.1%	3.6%	20.8%	29.4%	**37.1%**
Q4.1	7.1%	7.1%	22.8%	28.4%	**34.5%**
Q4.2	6.6%	7.6%	16.8%	28.9%	**40.1%**
Q4.3	8.6%	5.6%	21.3%	29.4%	**35.0%**
Q5.1	9.1%	13.7%	**29.4%**	24.9%	22.8%
Q5.2	5.6%	6.6%	24.4%	31.0%	**32.5%**
Q5.3	7.1%	6.6%	20.8%	22.3%	**43.1%**
Q6.1	13.2%	22.1%	**31.1%**	20.0%	13.7%
Q6.2	18.9%	22.6%	**32.6%**	17.4%	8.4%
Q7.1	4.6%	6.1%	17.9%	30.6%	**40.8%**
Q7.2	7.1%	7.1%	20.9%	**33.7%**	31.1%
Q8.1	17.8%	**60.4%**	16.8%	5.1%	-
Q8.2	18.3%	**60.4%**	16.8%	4.6%	-
Q9	7.7%	21.4%	28.6%	**42.3%**	-
Q10.1	17.9%	**60.2%**	18.9%	3.1%	-
Q10.2	25.0%	**54.6%**	17.3%	3.1%	-
Q10.3	33.2%	**51.0%**	13.8%	2.0%	-
Q10.4	42.9%	**44.9%**	9.7%	2.6%	-
Q11	19.8%	25.9%	**28.9%**	25.4%	-
Q12	1.5%	7.6%	**59.4%**	31.5%	-
Q13.1	2.0%	3.6%	15.7%	20.8%	**57.9%**
Q13.2	1.5%	6.6%	17.3%	26.4%	**48.2%**
Q13.3	2.5%	4.1%	31.0%	29.9%	**32.5%**
Q14.1	2.0%	2.5%	19.8%	24.9%	**50.8%**
Q14.2	2.0%	3.6%	9.6%	21.3%	**63.5%**
Q14.3	2.0%	4.6%	21.3%	28.9%	**43.1%**

Note:
(1) -: No option.
(2) Cells with grey mark indicate that the first two selections have differ by <5%.

For Question 5, "local sustainable development" is the most important factor affecting the brownfield redevelopment (Question 5.3, 43.1% for "*most important*"). The first two selections for Question 5.2 (How does local economic development affect the brownfield redevelopment?) are "*more important*" (31.0%) and "*most important*"

(32.5%). Accordingly, "local economic development" is the second important factor, and their importance varied significant among the participants in three cities. Finally, most participants selected "*some important*" (29.4%) or "*most important*" (24.9%) for Question 5.1 (How does central government or national plan affect the brownfield redevelopment). These results suggested that central government or national plan is relatively the least important factor and participants from different cities had diverse opinions towards its importance.

For Question 7.2 (In a well-established and proper city planning process, should third party be involved in decision making for city planning?), most participants chose "*to more involvement*" (33.7%) and "*most involvement*" (31.1%). This suggests that participants from different stakeholder groups or cities have different opinions towards the roles of third party in decision-making process for city planning, although its importance seems unassailable.

There is a large variation in the results of Question 11 (What do you think about the current roles of city planner in brownfield redevelopment?), which suggests distinct roles for city planners to involve in brownfield redevelopment process. Three options were selected similarly; *i.e.*, *limited role* (25.9%, City planner provides advices for the land use and function for brownfield redevelopment, but the key decision maker is brownfield redeveloper), *some important role* (28.9%, City planner and brownfield redeveloper work together on the land use and functions, determining remediation target, cost, strategy and other relevant issues for better decision in brownfield redevelopment) and *most important role* (25.4%, city planner determine the land use and function in city planning. Brownfield redevelopment must follow what is required in city plans, and add detailed strategies to achieve redevelopment target). Question 11 highlights that participants from different stakeholder groups or cities seemed to have entirely different opinions towards the involvement of city planners in the brownfield redevelopment process.

For Question 13.3 (How much should third party be involved in decision making for city planning?), three similar selections were made – i.e. *neutral* (31.0%), *more involvement* (29.9%), and *most involvement* (32.5%). Comparing the involvement of city planners (Question 13.1, 57.9% for "*most involvement*") and brownfield redevelopers (Question 13.2, 48.2% for "*most involvement*") in city planning, participants thought city planners and brownfield redevelopers are currently more

involved than members from third parties in the decision-making process for city planning.

From the brief summary of all question responses, participants from different stakeholder groups or cities share some common views but also hold different opinions towards how to consider brownfield redevelopment during the decision-making process for city planning. It is therefore important to identify the main factors causing the inconsistencies among participant groups or target cities, and explore the potential solutions.

5.3 General discussion and observations arising from the questionnaire

5.3.1 Factors affecting decision-making processes for city planning in China

Taken together, Questions 1-3 highlight:

- There is broad agreement between city planners, brownfield redevelopers and members of third party about the main purpose of city planning. However, among them, city planners from different cities have distinct opinions on the main purpose of city planning. City planners in Guangzhou city thought the purpose of city planning *to improve economic development* or *to improve urbanization level* rather than other options, whereas those in Wuhan and Shenyang city chose *to improve infrastructure construction* and *to improve urban environment*.
- City planners from all three cities believe that *central government or national plan* and *local economic development* are key objectives affecting decision-making for city planning. Brownfield redevelopers in Guangzhou and Wuhan selected *local economic development* and *local sustainable development* as the key driving forces.

5.3.2 Factors affecting decision-making processes for brownfield re-development in China

Question 5 highlighted some differences between stakeholders working in different cities as to the key factors affecting brownfield redevelopment. In Guangzhou it was

central government or national plan, whereas brownfield redevelopers from Shenyang and city planners from Wuhan believed it was local factors, for example.

5.3.3 Strong link between city planning and brownfield redevelopment in China

From the analysis above, although specific stakeholder (city planners, brownfield redevelopers, members from third party) in each city held different opinions towards the main factors affecting the decision-making process for city planning and brownfield redevelopment, there are general trends that '*local economic development*' is the most important driving force, followed by "*local sustainable development*". It is quite surprising that '*central government or national plan*' is of the least importance in all the cases. These results reflect the current situation that China has been experiencing a significant economic development in the past decades and reaches the late stage of urbanization and industrial structure adjustment. Economic development is one of the key driving forces for city planning, with all major cities having abandoned land to be reused. Accordingly, city planning is associated with the redevelopment of abandoned sites, many of which might be brownfields. City planning and brownfield re-development are therefore affected by similar driving forces.

Accordingly, the results from Questions 1 to 5 **support the first hypothesis, that there is a strong correlation between city planning and brownfield redevelopment**. As similar influential factors are identified in the decision-making process for city planning and brownfield redevelopment, the cohorts of urbanization and land redevelopment are found in many cities in China, showing the necessity to consider brownfield redevelopment in decision-making for city planning, which can benefit both city planning and brownfield *redevelopment.*

5.3.4 Consideration of brownfield re-development in the decision-making process for city planning

5.3.4.1 Current involvement of participants in city planning

The results of Question 6 suggested that the current involvement of both brownfield redevelopers and members from third parties is limited in the decision-making process for city planning in China (Figure 5.1), although brownfield redevelopers are slightly

more involved (Figure 5.1A and C). Of all three cities, members from third parties in Wuhan thought there is relatively more involvement of brownfield redevelopers, in comparison with other cities or groups of participants (Figure 5.1A), and participants in Wuhan all agreed that members from third parties are more involved in decision-making process for city planning (Figure 4.5B). As for the ideal consideration of brownfield redevelopment in the decision-making process for city planning, city planners from Shenyang and brownfield redevelopers from Wuhan showed distinct selection that the involvement of city planners or brownfield redevelopers in the decision-making for city planning are not important or its current situation does not require further change.

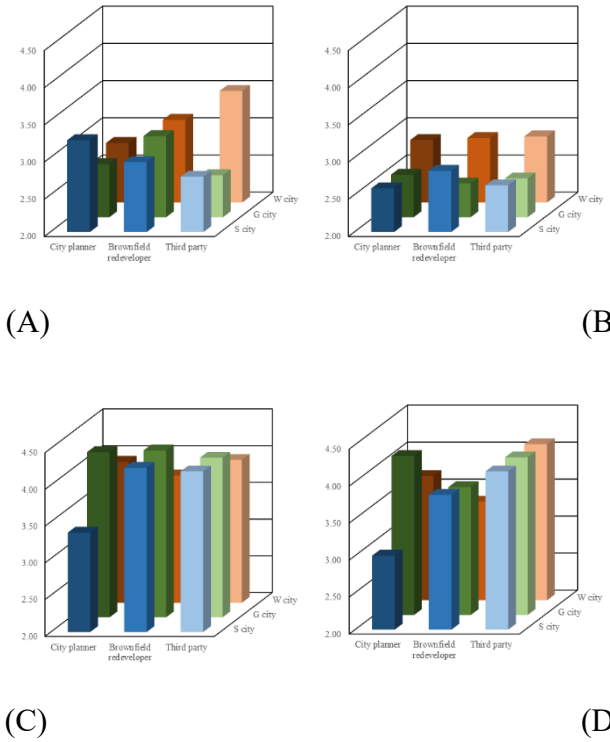
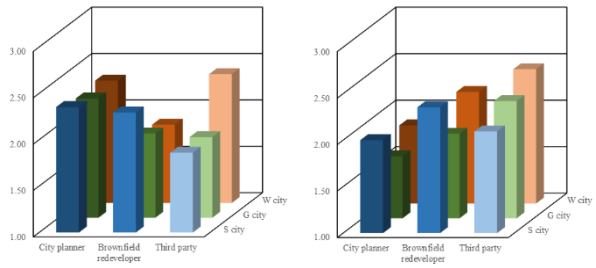


Figure 5.1 The current involvement of brownfield redevelopers (A) and members from third party (B) in decision making for city planning. In ideal situation, the involvement of brownfield redevelopers (C) and members from third party (D) in decision making for city planning. Higher values indicate more involvement. Data are from Questions 6 and 7 in the questionnaire.

5.3.4.2 Participants' familiarity with the decision-making process for city planning

As expected, city planners from all the cities were quite familiar with the decision-making process for city planning from the results of Question 8 (Figure 5.2A). It is worth mentioning that brownfield redevelopers from Wuhan and Guangzhou, as well as

members from third parties from Shenyang and Guangzhou, were most unfamiliar with decision-making for city planning. As for the decision-making process for brownfield redevelopment (Figure 5.2B), it is quite surprising that members from third parties were more familiar than brownfield redevelopers in Guangzhou and Wuhan, whereas it was the opposite in Shenyang. City planners were the least familiar with the decision-making process for brownfield redevelopment in all the three cities, suggesting their limited consideration of brownfield redevelopment in city planning or that they are not involved much in the brownfield redevelopment process.



(A) (B)

Figure 5.2. Participants' familiarity in decision-making for city planning (A) and brownfield redevelopment (B). Higher value means more familiarity. Data are from Question 8 in questionnaire.

5.3.4.3 Consideration of brownfield redevelopment with the decision-making process for city planning by city planners

The results of Question 9 documented city planners' consideration of brownfield redevelopment in the decision making for city planning, as illustrated in Figure 5.3. City planners from Shenyang suggested that decision-making for city planning should fully consider brownfield redevelopment. Shenyang has a longer history of industrial contamination and recent mega projects of brownfield redevelopment compared to Guangzhou and Wuhan. Brownfield redevelopers from Guangzhou ranked the second and mainly suggested high level consideration of brownfield redevelopment during city planning process, whereas city planners from Guangzhou thought there should be only limited consideration. All the other participants had similar ideas that *moderate consideration* of brownfield redevelopment should be performed in decision-making for city planning.

5.3.4.4 Limited consideration of brownfield redevelopment in the decision-making process for city planning in China

Results in this section identified that there is only limited involvement of brownfield redevelopers and members from third parties in the decision-making process for city planning, although they all agreed with more involvement of them in the ideal situation (Figure 5.1). City planners thought that they properly consider brownfield redevelopment in city planning, but neither brownfield redevelopers nor members from third parties agree with that (Figure 5.3).

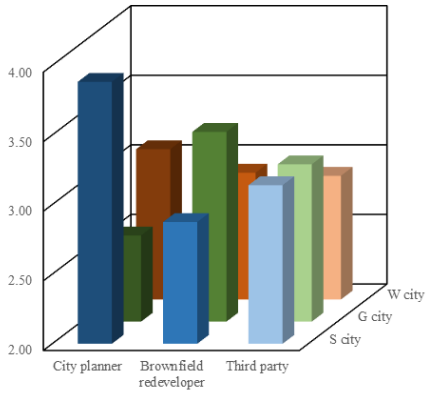


Figure 5.3. City planners' consideration of brownfield redevelopment in decision making for city planning. Higher values mean more consideration of brownfield redevelopment in decision making for city planning. Data are from Question 9 in questionnaire.

Thus, the **second hypothesis is supported, namely that decision-making for city planning in China does not fully consider brownfield redevelopment, which restricts appropriate brownfield management.** This may be attributed to the unfamiliarity of city planners with brownfield redevelopment, so that they cannot appropriately consider brownfield redevelopment in the decision-making process for city planning.

5.3.5 Factors restricting the consideration of brownfield redevelopment in the decision-making process for city planning in China

5.3.5.1 Challenges to consider brownfield redevelopment in the decision-making process for city planning.

Data from Question 10 showed that participants were more aware of '*current situation of land use*' and '*contamination level of land use*' than '*number and location of brownfield* sites' and '*contamination level of brownfield*' (Figure 5.4). It suggested that they are getting more information about brownfield redevelopment, but the lack of sufficient databases describing the details of brownfields restricts their further awareness. Among participant groups, brownfield redevelopers and members from third parties had more awareness of all the four levels of information related to brownfield redevelopment (Figure 5.4). It is worth mentioning that brownfield redevelopers from Shenyang and Wuhan were more aware of the information than those from Guangzhou (Figure 5.4 C and D) and members from third parties in Wuhan had greater awareness than those in the same participant group from the other two cities.

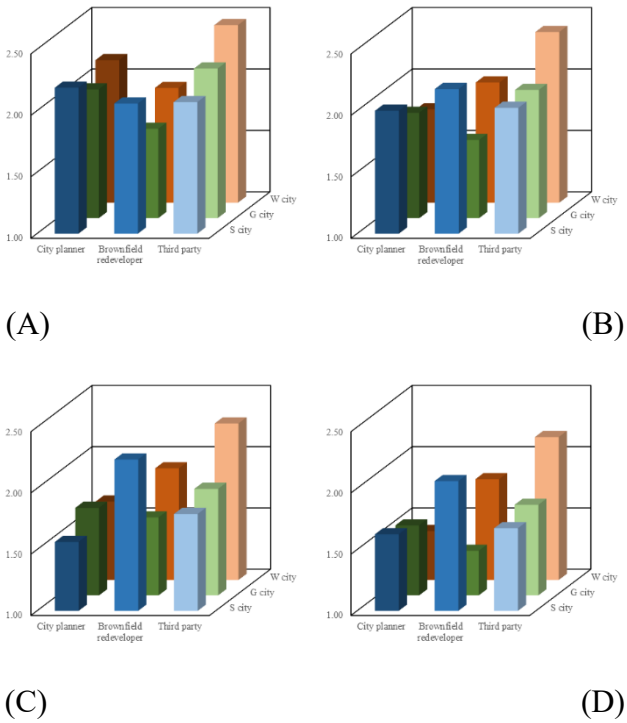
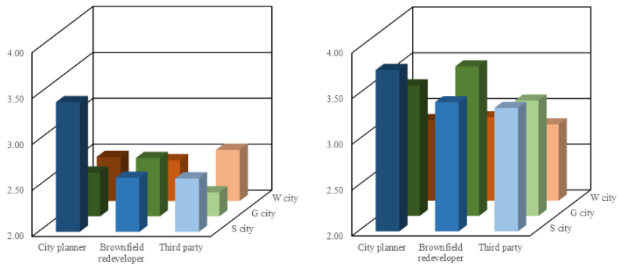


Figure 5.4. Awareness of information related to brownfield redevelopment. (A) "*current situation of land use*", (B) "*contamination level of land use*", (C) "*number and location of brownfield*", (D) "*contamination level of brownfield*". Higher data indicate more awareness. Data are from Question 10 in questionnaire.

5.3.5.2 Ideal decision-making process for city planning to effectively consider brownfield redevelopment

Similar as Question 9, an unexpected result in Question 11 suggested that city planners generally thought that the current roles of city planners in brownfield redevelopment are not significant (Figure 5.5A), although Shenyang planners responded rather differently. The other participants, generally suggested the current roles of city planners in brownfield redevelopment were limited and required significant improvement. Brownfield redevelopers from Guangzhou ranked the second and mainly suggested high level consideration of brownfield redevelopment during city planning process, whereas the city planners from Guangzhou thought there should be only limited consideration (Figure 5.5B). Participants generally believed that (only) *moderate consideration* of brownfield redevelopment should be incorporated in decision-making for city planning.

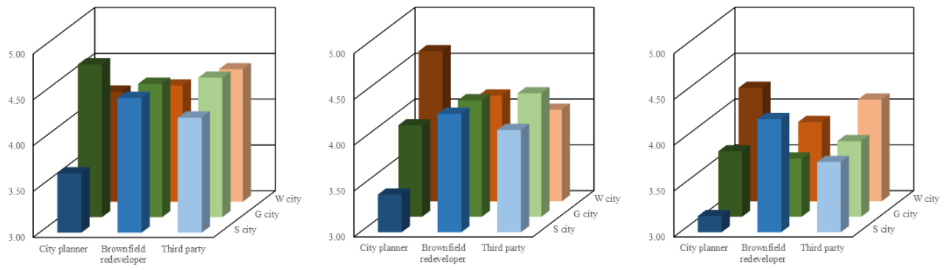


(A) (B)

Figure 5.5. The current (A) and ideal (B) roles of city planners in brownfield redevelopment. Higher values indicate more involvement and important roles. Data are from Questions 11 and 12 in questionnaire.

All the participants have similar opinions, that ideal involvement and cooperation of city planners in decision-making for city planning should be of high-level (Figure 5.6), except for the city planners from Shenyang. For the ideal involvement and cooperation of brownfield redevelopers, all the participants suggested a similar and moderate opinion, and the only exceptions were city planners from Shenyang who thought it should be of low level and city planners from Wuhan who suggested an extremely high level of involvement and cooperation. Views on the ideal involvement and cooperation of members from third parties were diverse; city planners from Shenyang again suggested low-level involvement, whereas city planners and members from third parties

from Guangzhou and brownfield redevelopers from Shenyang preferred high-level involvement and cooperation.

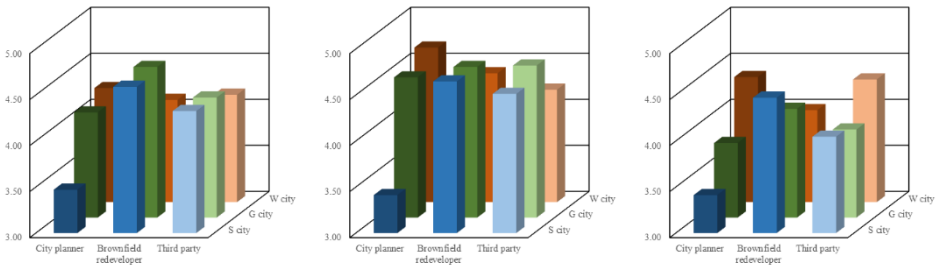


(A) (B) (C)

Figure 5.6. The ideal involvement and cooperation of city planners (A), brownfield redevelopers (B) and members from third parties (C) in decision-making for city planning. Data are from Question 13 in questionnaire.

Across all the involvement and cooperation, the participants generally suggested most for city planners, followed by brownfield redevelopers and then members from third parties. There is no significant difference in the suggestions of the same group of participants for their own involvement and cooperation comparing to other participants. All the other participants suggested the strongest roles of city planners in decision-making for city planning, slightly higher than those of brownfield re-developers. The roles of members from third parties were the lowest.

The participants from Guangzhou and Wuhan suggested that in an ideal situation, there should be more involvement of brownfield redevelopers than members from third parties in city planning (see Question 14 and Figure 5.7). Compared to the current situation, such involvement should be significantly improved. City planners from Shenyang held the opposite opinion, namely that the involvement of both brownfield redevelopers and members from third parties does not need improvement, whereas brownfield redevelopers and members from third party suggested some improvement.



(A) (B) (C)

Figure 5.7. The ideal involvement and cooperation of city planners (A), brownfield redevelopers (B) and members from third party (C) in decision-making for brownfield redevelopment. Data are from Question 14 in questionnaire.

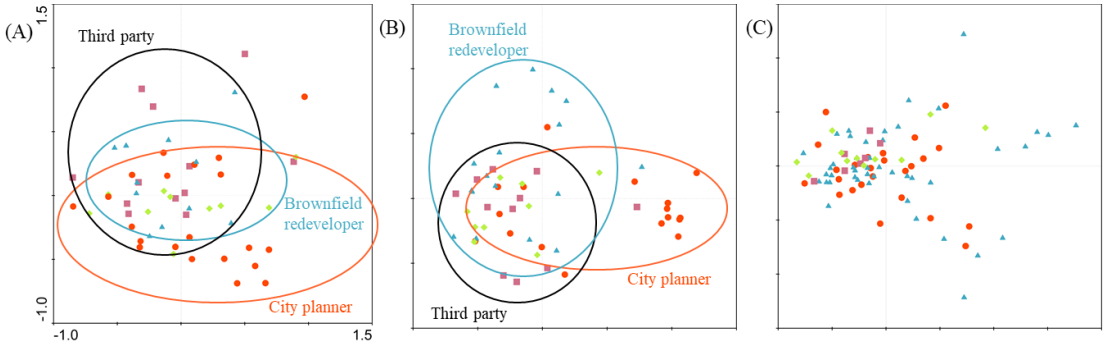
5.3.5.3 Different decision-making processes in city planning for brownfield redevelopment across cities and participant groups

To evaluate whether participants from different stakeholder groups (city planners, brownfield redevelopers and members from third party) or cities (Shenyang, Wuhan and Guangzhou) have the same opinions towards all the questions in the questionnaire, principle component analysis (PCA) was carried out, to assess the selections of all the questions in the questionnaire. PCA score plots suggested that participants from the three cities showed distinct patterns, as illustrated in Figure 5.8. Here, the first principle component (PC1) and second principle component (PC2) account for 48.2% and 35.4% of the total variance of all the selections. PC1 mainly consisted of questions related to the decision-making process for city planners, and PC2 is associated with brownfield redevelopment. It suggests that participants' opinion towards each question related to city planning and brownfield redevelopment have convergence to separate or cluster participant groups to distinguish their consistency.

Overall, the PCA score plots suggested that a significant separation was achieved for participants in Guangzhou and Shenyang, indicating that participants from these two cities held different opinions towards the consideration of brownfield development in the decision-making process for city planning. To be more precise, the participants from Guangzhou had slight differences, with closer distances between each stakeholder group (Figure 5.8A), whereas participants from Wuhan had more similar opinions and they are clustered together (Figure 5.8C). In Shenyang, city planners, brownfield

redevelopers and members from third parties had significantly different choices as their groups are separated in the PCA score plot (Figure 5.8B).

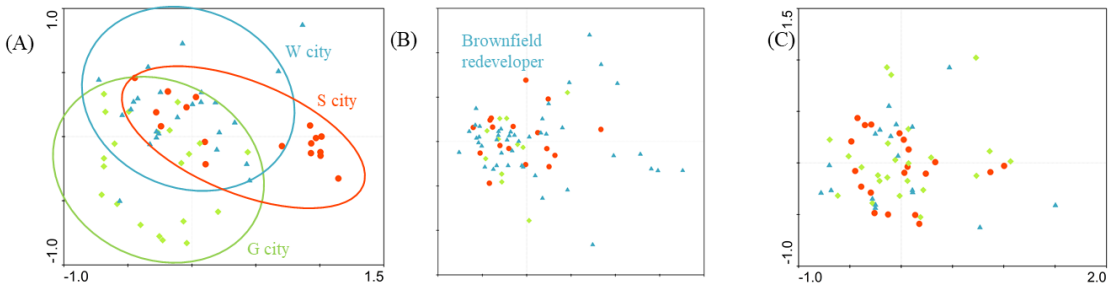
By comprehensively analyzing the contribution of individual questions to the total variance, the segregation in Shenyang and Guangzhou was mainly caused by the different opinions towards the ideal involvement and cooperation of participants in city planning and brownfield redevelopment (Questions 13 and 14 in questionnaire, explaining 10.1% and 7.6% of the total variance). City planners in Shenyang believed in a significantly less involvement of all the three participant groups in those activities, whereas city planners from the other two cities (Wuhan and Guangzhou) suggested relatively higher levels of involvement.



(A) (B) (C)

Figure 5.8. PCA score plots for the difference in opinions across participant groups in the same city. (A) Guangzhou, (B) Shenyang, (C) Wuhan. Data are from all the questions.

Another PCA addresses different stakeholder groups (city planners, brownfield redevelopers and members from third party), and the score plots also showed the differentiated opinions of three individual participant groups (Figure 5.9), illustrating that only city planners had significantly different choices (Figure 5.9A), whereas brownfield redevelopers and members from third parties exhibit similar opinions (Figure 5.9B and 5.9C). Among all the city planners, those from Shenyang showed more distinct behavior compared with those from Wuhan and Guangzhou, as they were clustered towards PC1 (Figure 5.9A).



(A) (B) (C)

Figure 5.9. PCA score plots for the difference in opinions across cities in the same participant group. (A) City planner, (B) Brownfield redeveloper, (C) Members from third party. Data are from all the questions.

5.3.5.4 Suggestions for improving brownfield redevelopment during the decision-making process for city planning in China

Analyses in this section revealed that the awareness of brownfield information ('*current situation of land use*', '*contamination level of land use*', '*number and location of brownfield*', '*contamination level of brownfield*') varies significantly across participant groups (Figure 5.4). Brownfield redevelopers and members from third parties are more aware of brownfield information than city planners, and the knowledge gap tends to enlarge for detailed information about location and contamination level of brownfield. Most participants agree that the current roles of city planners in brownfield redevelopment is too weak and should be much improved in the ideal situation (Figure 5.4).

Thus, **the third hypothesis, that 'there are some key influential factors restricting the consideration of brownfield redevelopment during decision-making for city planning and that further implementation should address these influential factors to solve the problem" is supported**.

5.4 Summary and discussion

The analyses in this chapter suggest a strong link between city planning and brownfield redevelopment. More precisely, all the participants agreed about the main driving forces for the decision-making process for city planning and brownfield redevelopment (i.e. '*local economic development*' and '*local sustainable development*'. Accordingly, they

are influenced by the same demands of city development and the current changes of city designs leaves abandoned sites which require both city planning and brownfield redevelopment. This result is consistent with Seto's finding, that contemporary urbanization is determined by the economic development and functions, and the relationship between urbanization and the environment is shaped by many economic and sustainable forces (Seto et al., 2010). Thus, the strong link between city planning and brownfield redevelopment highlights that the decision-making process for city planning should consider brownfield redevelopment, as it generates clean land for future use and benefits the design of city functions.

The different driving forces on decision-making for city planning across cities hinted that the current economic development level affects the decision-making process. Shenyang is one of the oldest and largest industrial cities in China, and its industrial development has slowed down in the past two decades, compared to Guangzhou and Wuhan. Shenyang's economic development still has the frame of a 'planned economy', thus they regard '*central government or national plan*' as the most important driving force for city planning. As for Guangzhou and Wuhan, with the rapid economic development since China's reform and opening, they are stepping into the second stage of city development, which is urban functional renovation and upgrade. In other words, traditional industries are moving out and leave many abandoned brownfields. In this case, city planning is driven more by '*local sustainable development*' and focuses on the change of city lay-out and the transfer brownfields into clean land with new functions. Similar ideas are reported by previous works, namely that city planning policies are more important in transforming brownfields into housing or commercial lands, and green remediation strategies are suggested to achieve city sustainable development (Krajnik et al., 2017; Song et al., 2019).

It is worth mentioning that city planners have different opinions on the purpose of city planning. The main reason causing such differences might be the key roles of city planners in decision-making for city planning, as they need to think about the current situation of urbanization and the key challenges for city development. The variance of urbanization levels across cities therefore drives the different objectives of city planning. Ma's work has similar ideas, namely that Chinese city development has transformed from centralized planning and city-based industrialization to spatial reorganization as polycentric restructuring of urban form (Ma, 2002). The differentiation in levels of

urbanization and industrial revolution across the three target cities strongly hints that brownfield redevelopment is increasingly required for city planning as they have similar goals to improve city sustainability. In contrast, no significant difference is found in opinions from brownfield redevelopers and members of third parties, possibly attributed to their limited roles in decision-making for city planning. They are led by city planners in the city planning process and their main roles are to provide relevant information to help decision-making in city planning, which is quite close to their daily duty, instead of city planning. They therefore have quite similar tasks during decision-making processes for city planning and do not have clear visions towards the purpose of city planning.

The involvement of brownfield redevelopers and members from third party is limited for city planning, and all participants suggest their involvement should be improved -in the ideal situation. In China, decision makers are normally a group of policy makers as representatives of government officers, city managers, members from national or municipal institutions, and planning experts, who can recognize the future land use and manage a set of city planning. Brownfield redevelopers and members from third parties are currently not included on the decision-maker board in Chinese cities and their involvement is therefore lacking. Previous studies also have similar conclusions, namely that the main decision-makers for city planning are in the area of metropolitan design, highways, etc. (Flores et al., 1998). As for the ideal decision-makers for city planning, increasingly reports have suggested the involvement of members related to environmental assessment, including brownfield redevelopers. For instance, from a survey on city planners and developers (Stezar et al., 2014), city planners can contribute to more efficient use of public economic development resources by recognizing brownfields with the assistance of brownfield redevelopers and other members. Additionally, the benefits of climate change mitigation and public health should also be addressed in city planning process by considering brownfield redevelopment to achieve sustainable development (Kabisch et al., 2016). Particularly for those cities with many brownfield sites to be cleaned and regenerated, the involvement of brownfield redevelopers and members from third parties is more important and necessary.

Owing to the limited involvement of brownfield redevelopers and members from third parties in city planning, brownfield redevelopment is generally seldom considered in the decision-making process for city planning in China. However, many decision

makers in China do not consider other relevant issues and continue to pay little if any attention to further improvement of city planning, such as brownfield redevelopment, public health (Greenberg et al., 1994), sustainability (Murdoch, 2004), etc.

From this questionnaire survey, although city planners from Shenyang think they have fully considered brownfield redevelopment for city planning, those from Wuhan and Guangzhou city hold different opinions, and the brownfield redevelopers and members from third parties do not agree with a satisfactory consideration. This difference might be attributed to the intensive brownfield clean-up and redevelopment cases in Tiexi District of Shenyang (Ren et al., 2014; Xue et al., 2016; Zhang et al., 2016). The brownfields in Tiexi District have been marked and carefully designed during the city planning process to maintain their future use for housing. In contrast, both brownfield redevelopers and members from third parties believe brownfield redevelopment is only of limited consideration in the decision-making process for city planning in China, showing a large gap between different stakeholder groups (city planners, brownfield redevelopers, and members from third party). It is important to further identify the key reasons causing such unanimous opinions.

To identify the key influential factors restricting the consideration of brownfield redevelopment in the decision-making process for city planning, Questions 10-14 further collected participants' opinions. The results identify that the (lack of) awareness of brownfield information is one of the key factors restricting the consideration of brownfield redevelopment in the decision-making process for city planning in all cities. Understanding the situation and details of brownfields, *e.g.*, number, location, contamination characteristics, are important for properly consider brownfield redevelopment. Nevertheless, all the participants have moderate awareness of the '*number and location of brownfield*s', and the knowledge about '*contamination level of brownfield*' is even worse. Additionally, brownfield redevelopers only show slightly better awareness of the brownfield situation, and the level is not satisfactory. Regarding this, it is hard for city planners or brownfield redevelopers to properly identify brownfields on the city planning map; it challenges the consideration of brownfield redevelopment in the decision-making process for city planning.

Regarding participants' opinions towards the ideal decision-making process for city planning to effectively consider brownfield redevelopment, the roles of brownfield redevelopers and members from third party should be significantly improved. Taken

together the roles of city planners in the ideal decision-making process for brownfield redevelopment, the three main participant groups including city planners, brownfield redevelopers and members from third party seem to have equal roles in the decision-making for either city planning and brownfield redevelopment. This result strongly hints at the combination of decision-making processes for these two activities. As Chinese urban planning and development control has been transformed from a centrally-planned to transitional economy (Yeh and Wu, 1999), it is important to set up the integrated system to consider several plans together to properly address this problem. For example, the Environmental Information System for Planners (EISP) is a suggested system offering potential economic benefits and efficiency savings for both planners and developers, by considering brownfield redevelopment and other environmental issues (Culshaw et al., 2006). Lack of such integral planning system is the second restriction factor affecting the consideration of brownfield redevelopment in the decision-making process for city planning.

6. Qualitative survey results

6.1 Introduction

In this chapter, the results of qualitative interviews are summarized and analyzed, to give a deeper understanding the current situation and driving forces for considering brownfield redevelopment in the decision-making process for city planning. The first part of the chapter focuses on the current and changing decision-making process during city planning in China. The second part evaluates the extent and how brownfield redevelopment is considered in the decision-making process for city planning in China. The third part attempts to identify the different decision-making processes for city planning and its mechanisms across the three target cities. The fourth section compares brownfield management strategies between Chinese and western cities and comprehensively discusses the challenges to consider brownfield redevelopment in the decision-making process for city planning in China. Based on the results above, the final part of this chapter develops an ideal decision-making process for city planning and suggests a novel systematic scheme for considering brownfield redevelopment in the decision-making process for city planning.

6.2 Overall interview results

Generally, among all the interviewees, some specific participants or stakeholder groups answered the questions better than other participants, providing more detailed information and suggestive recommendations. Several city planners from Wuhan (junior or senior) or Shenyang explained very detailed information related to the decision-making process and activities for city planning, and their understanding on the key driving forces restricting the consideration of brownfield redevelopment in the decision-making process for city planning. A brownfield redeveloper in Wuhan and a member of third party in Guangzhou are both familiar with the brownfield redevelopment process and aware of key steps in the decision-making process for city planning. They therefore provided valuable answers from brownfield redevelopment perspectives how to improve brownfield redevelopment in city planning and some practical suggestions to implement the management system for effectively considering brownfield redevelopment in the decision-making process for city planning. These interviewees' answers and suggestions are the main materials used in this chapter to build up a concrete map on the current situation and implementation strategies for

brownfield redevelopment during city planning process.

Generally, qualitative interview results are consistent with questionnaire and further summarize the deeper understanding of participants on the current situation and driving forces for considering brownfield redevelopment in the decision-making process for city planning. In fact, most participants have realized the limited roles of brownfield redevelopers and third party in either city planning and brownfield redevelopment process, and pointed out that improving involvement of brownfield redevelopers in the decision-making process for city planning is urgent and effective approach for better design of city plan and sustainable brownfield redevelopment.

6.3 Current decision-making process for city planning in China

6.3.1 Questions

The questions in interview targeting the current decision-making process for city planning in China include:

1) Can you briefly describe the key steps in decision-making process for city planning? Is this decision making for city planning step by step (incremental) or in one go (rationale)? (city planners)

2) Are you familiar with the decision-making process for city planning? Is this decision making for city planning step by step (incremental) or in one go (rationale)? (brownfield redeveloper, members from third party)

3) Does the practical city planning process follow 'National Urban and Rural Planning' Art? Do you think the practical decision-making process for city planning is the same as the Chinese national guidelines? (city planners)

4) Which is the key driving force for city planning in your city? (city planners, brownfield redevelopers, members from third party)

5) Do you think the current decision-making process for city planning is effective? (city planner, brownfield redeveloper, members from third party)

6.3.2 Results

Of 66 participants taking the interview, 45 participants answered questions in this category. Participants from three different cities suggest distinctly different purposes for

city planning across cities, similar as the findings in a survey between two cities in Czech (Navratil et al., 2018). Local economic development seems the main driving force in Guangzhou city. For instance, a member from a third party from Guangzhou city believes economic development and urbanization level is the main purpose of city planning, and points out that the national standard is the key in decision-making for city planning:

"*City planning in Guangzhou focuses more on economic development and urbanization level. Normally, the mega city planning also follows the national standard, and the national plan is important for city planning in Guangzhou.*"

-Member A from third party from Guangzhou

As for city planners in Wuhan, they think future economic development is the main purpose of city planning, whereas the opinions from members of third party is quite diverse. Some city planners suggest economic development is the priority in city planning, whereas brownfield redevelopers and members from third parties think eco-civilization or an appropriate balance between economic development and eco-civilization is more important.

"*The main purpose and influential factor for the city planning in Wuhan is to allocate urban spatial layout properly to meet with the requirement of future economic development.*"

-City planner C from Wuhan

"*The priorities of city plan in Wuhan: city economic development and infrastructure construction > urbanization level > improving environment quality > sustainable development. Accordingly, ecological civilization is not the priority of city development and not well considered in city planning.*"

- Brownfield redeveloper A (senior) from Wuhan

"*The overall system of city planning is complete and technically well, but the main target is eco-civilization.*"

- Brownfield redeveloper A (senior) from Wuhan

"*The criteria in city planning should follow the actual situation of the city. In Wuhan, sustainable development is the key issue for city planning.*"

- City planner A (junior) from Wuhan

"*Land use is dependent on economic development. Currently, the land use in Wuhan is attempting to balance economic development and city sustainability.*"

- City planner A (junior) from Wuhan

The results from the quantitative questionnaire and the qualitative interview are consistent and suggest that for most cities in China, economic development is the main purpose for city planning, although in some cities or for some members of third parties, eco-civilization or city sustainability should be taken as more important for city planning.

6.4 Consideration of brownfield redevelopment in the decision-making process for city planning

6.4.1 Questions

The questions in interview targeting the consideration of brownfield redevelopment in the decision-making process for city planning include:

1) Is brownfield redevelopment considered in the decision-making process for city planning? (city planner, brownfield redeveloper, members from third party)

6.4.2 Results

Of 66 participants taking the interview, all participants answered questions in this category. Most participants think there is only limited consideration of brownfield redevelopment in the decision-making process for city planning from the qualitative interview. For instance, city planners in Wuhan city did not fully consider brownfield redevelopment in city planning, as:

"*Currently, policies and regulations on city planning are well established and easy to be carried out top-down. The whole procedure strictly follows the national standard with supervision in place. The key challenge is to strengthen implementation efforts in the practical process.*"

-City planner B (senior) from Wuhan

Additionally, a brownfield redeveloper in Wuhan city directly pointed out that the limited consideration of brownfield redevelopment in the decision-making process for city planning is caused by limited involvement of third party and brownfield redevelopers in city planning:

"*Currently, there is only limited involvement of third party and brownfield redevelopers in city planning.*"

- Brownfield redeveloper A (senior) from Wuhan

Similarly, a city planner in Shenyang points out that city planning in Shenyang follows a similar situation as Wuhan in that brownfield redevelopment is limited in consideration by city planners:

"*Currently, city planning has some consideration on brownfield redevelopment with a general view, including how to protect and remediate contaminated soils.*"

-City planner A from Shenyang

Results of qualitative interview are consistent with those of questionnaire again, indicating that there is actually limited consideration of brownfield redevelopment in the decision-making process, and how to improve the involvement of third party and brownfield redevelopers in city planning is the key to making future improvements.

6.5 Different decision-making processes in city planning for brownfield redevelopment in different cities

6.5.1 Questions

The questions in the interview targeting the different decision-making process in city planning for brownfield redevelopment in different cities include:

1) Which is the key driven force for brownfield redevelopment in your city? (brownfield redeveloper, members from third party)

6.5.2 Results

Of 66 participants taking the interview, 36 participants answered questions in this category, as some brownfield redevelopers were not familiar with the decision-making process for city planning. Consistent with the PCA score plots (Figures 5.8 and 5.9)

again, city planners and other participants hold distinct opinions, and the situation varies across the three cities.

City planners in Wuhan think brownfield redevelopment has been properly carried out locally, and the main driving force is local sustainable redevelopment after moving industrial companies out of the city centre. One example is:

"*In Wuchang District, there are many brownfields and thus some good cases of brownfield redevelopment.*"

-City planner A (junior) from Wuhan

6.6 *Challenges to consider brownfield redevelopment in the decision-making process for city planning*

6.6.1 Questions

The questions in interview targeting the challenges to consider brownfield redevelopment in the decision-making process for city planning include:

1) Are you aware of brownfield situation in your city? (city planner, brownfield redeveloper, members from third party)
2) What do you think is your roles in brownfield redevelopment? (city planner)
3) What do you think is the roles of city planner in brownfield redevelopment? (brownfield redeveloper, members from third party)
4) How about your relationship with brownfield redeveloper and third party? (city planner)
5) How about your relationship with city planner and third party? (brownfield redeveloper)
6) How about your relationship with city planner and brownfield redeveloper? (members from third party)

6.6.2 Results

Of 66 participants taking the interview, 52 participants answered questions in this category. They all agreed that they have limited awareness of brownfield information, and brownfield redevelopers and members from third party have limited involvement in the decision-making process for city planning. Consequently, there is limited

consideration of brownfield redevelopment in decision-making for city planning, as suggested by interviewers.

Some of the responses by participants help identify contributory factors. Firstly, time challenges the current city planning process, if considering brownfield redevelopment, as pointed out by a senior brownfield redeveloper in Wuhan:

"*Facing the problems of brownfield redevelopment, current city planning suffers from the multiple revisions, which is time and resource consumption. It is suggested to fully consider brownfield redevelopment during city planning process from technical point of view to increase the efficiency of city planning and land redevelopment.*"

- Brownfield redeveloper A (senior) from Wuhan

Secondly, the importance of ecological civilization is not well recognized by many city planners, as raised by members of third party from Wuhan.

"*It is not appropriate to set up economic development scheme without considering ecological civilization, present situation of land use and the presence of brownfield.*"

- Brownfield redeveloper A (senior) from Wuhan

City planners from Shenyang and Wuhan pointed out a third reason, which was the limited power of brownfield redevelopers in decision-making for city planning:

"*Previously, the environment protection agency did not have the power in the decision-making for city planning, and its main roles are providing information to help decisions.*"

-City planner A from Shenyang

"*Since city planning and environment protection belong to two separate departments in the government, city planning is normally required by the top officers from the Ministry of Land Use/Resources. After planning and prior to construction, the land needs to be investigated to meet the requirement of environmental regulations. In other words, the land cannot be transferred or redeveloped until the land investigation and evaluation.*"

- Brownfield redeveloper A (senior) from Wuhan

"*The key challenge for the collaboration of city planners, brownfield redevelopers and third parties in decision making for city planning is their different viewpoints and interest demands. For instance, members from third party normally do not take economic development as priorities. Instead, they focus more on city ecology, humanistic harmony, etc. On the contrast, city planners and government officers address urban management and economic development more than other aspects.*"

-City planner A (senior) from Wuhan

One of city planners from Shenyang pointed out that only limited information of brownfields, normally the number and area, was considered in city planning as they were planned for future land use.

"*Ten years earlier, environment protection normally considered the number and area of brownfield to be remediated and redeveloped. Accordingly, the main task was to set up clear goals and plans for individual brownfield sites for future land use. There was no plan or spatial consideration of whether the plan is appropriate or fits well with city planning. The good example is the brownfield redevelopment in Tiexi District, the largest industrial district in Asia.*"

-City planner A from Shenyang

"*During the decision-making process of city planning, city planners think they have asked advice from brownfield redevelopers and their involvement is significant. However, the top decision makers know well about the decision-making process in city planning and land reuse. Most of the city planners consider the land reuse a little, passively but not initiatively. They will keep the information and do not plan the future use of the land with risks or with serious contamination, but not put the concept and practice of "brownfield redevelopment" as priorities, as economic development is the priority of Wuhan.*"

- Brownfield redeveloper A (senior) from Wuhan

"*The environment protection agency and relevant departments are not the ones providing brownfield data and information in the city planning process. They should also direct the city planning process to keep the ecological civilization and environment protection as the key concept.*"

- Brownfield redeveloper A (senior) from Wuhan

Several interviewers also raised the challenges in brownfield redevelopment, which need the corporation of city planners.

"*Environment protection does not consider spatial variation, and the spatial system should be well established together with other plans.*"

-City planner A from Shenyang

6.7 Ideal decision-making process for city planning to effectively consider brownfield redevelopment

6.7.1 Questions

The questions in interview targeting the ideal decision-making process for city planning to effectively consider brownfield redevelopment include:

1) What do you think about the relationship between city planning and brownfield redevelopment? (city planner, brownfield redeveloper, members from third party)

2) Any suggestions for further city planning and brownfield redevelopment? (city planner, brownfield redeveloper, members from third party)

6.7.2 Results

Of 66 participants taking the interview, nearly all participants answered questions in this category. They seem to have realized the current necessity and challenges of considering brownfield redevelopment in the decision-making process for city planning, and were willing to offer suggestions to improve the current city planning process from their own practical experience.

City planners from Wuhan also suggested to improve city planning by geographic location and economic development, not including brownfield redevelopment, in future implement.

"*City master plan should clearly raise the main objective of city planning based on the geographic location and current economic development, whereas regulatory plan should follow the master plan for more details.*"

-City planner A (senior) from Wuhan

From interview, city planners from Shenyang pointed out that, in regional planning, brownfield and its development should be considered by city planners, whereas the current situation is not satisfactory.

"*Besides city planning, more focus should be put on regional planning. Planners should list 'how to remediate contaminated soils', 'how to protect soils with potential risk to be contaminated' for planning.*"

-City planner A from Shenyang

The roles of brownfield redevelopers in brownfield redevelopment

"*Brownfield redevelopers are the key decision makers for brownfield redevelopment plans. Their main roles are to approve (planning propose stage), supervision (planning process stage), involvement (acceptance stage) and suggestion (advice stage).*"

- Brownfield redeveloper A (senior) from Wuhan

"*Brownfield remediation is under the control of brownfield redevelopers and members of third parties, but the remediation target is determined by the environment protection agency.*"

- Brownfield redeveloper A (senior) from Wuhan

"*Currently, city planners are only simply involved in the decision-making of brownfield redevelopment. Brownfield redevelopers are the key decision-maker. In ideal mode, both city planners and brownfield redevelopers should work together on the decision-making of brownfield redevelopment. Currently, the majority of brownfield redevelopers have limited knowledge about city planning. Instead, they only care about individual sites or brownfields, without overall views on the whole city planning process. It is better to consider both overall city planning and details of individual brownfield in the decision-making process of both city planning and brownfield redevelopment.*"

- Member A from third party from Guangzhou

A city planner from Shenyang highlighted one challenge, investment, for brownfield redevelopment. In fact, it has been raised by many researchers that investment is a critical factor in brownfield redevelopment across China, as a huge amount of capital is required for brownfield evaluation and re-development in the near future.

"*One concern is about the investment for brownfield redevelopment. It is not feasible and sustainable for government investment for all the brownfield remediation, and a potential solution is to introduce appropriate economic policies to encourage private capital (market solution).*"

-City planner A from Shenyang

Furthermore, the correlation between city planners, brownfield redevelopers and members of third party was uncovered from interview results. City planners from Wuhan highlighted that city planners only negotiate with brownfield redevelopers when the brownfield redevelopment problem was raised, either by the government or the public. In this case of limited communication, there was lack of sufficient information about the distribution and characteristics of brownfield for city planners to take during city planning process.

"*During the process of brownfield redevelopment, city planners negotiate with the environment protection agency and brownfield redevelopers to a limited extent. They only communicate when the problem of brownfield redevelopment is raised from the planning perspective. For the daily planning process, there is only limited communication and most discussions focus on the individual brownfield.*"

-City planner A (senior) from Wuhan

Additionally, the involvement of third parties in decision-making for city planning was confirmed by a city planner from Wuhan. From their point of view, members from third parties are important for city planning, especially for city mega plan.

"*Members from third parties, such as the public and experts in city planning, are well involved in the decision-making process for city planning. Particularly for mega projects, the involvement of third party is absolutely necessary.*"

-City planner A (senior) from Wuhan

All the participants suggested a moderate level of involvement is ideal and cooperation of city planners in brownfield redevelopment, except for city planners from Shenyang and brownfield redevelopers from Shenyang and Guangzhou. Comparing to results from Q13, less involvement of city planners in brownfield redevelopment were suggested than that in city planning, as expected.

Views on the ideal involvement and cooperation of members from third party in the decision-making for brownfield redevelopment was also diverse, illustrating similar results to those on the ideal involvement and cooperation of members from third parties in city planning. Participants suggested an equal role of third parties in decision-making for both city planning and brownfield redevelopment.

All the city planners from Shenyang city suggested weak but equal roles for all the participants in city planning and brownfield redevelopment. All the other participants suggested the strongest roles should be for brownfield redevelopers, slightly higher than those of city planners. The roles of members from third party were the lowest.

The ideal role of brownfield redevelopers in city planning is different.

"*Ideally, brownfield redevelopers should highly participate in the city planning process, whereas the involvement of third parties is not that important.*"

- Brownfield redeveloper A (senior) from Wuhan

"*There is not sufficient public involvement in city planning. Brownfield redevelopers are only involved in the decision-making for city planning when the planned site is potentially contaminated. One of the key reasons is that most of the brownfield redevelopers are not professional in city planning.*"

- City planner A (junior) from Wuhan

"*The main role of third parties in city planning is at the technical level, and thus they do not have strong power in decision-making. In the current mode, there are two limitations. Firstly, how these departments can co-operate to efficiently make decisions is a challenge. The best solution is that government has the power to decide the roles of individual departments in planning. Secondly, the co-operation or negotiation process normally takes a long time, challenging the technical staff who spend more time on revising the plan. For instance, regional plan at county level normally takes about 1 to 2 years to complete.*"

- Member A from third party from Guangzhou

6.7.3 Challenges and recommendations raised during the interviews

Some challenges regarding brownfield redevelopment were raised through the interview by either city planners, brownfield redevelopers and members from third

parties.

Firstly, from the political point of view, the main purpose of city planning still addresses the economic development, and how to introduce brownfield redevelopment as a complementary component in decision-making for city planning is a huge challenge to improve brownfield management and choose appropriate strategies in brownfield remediation.

"*Although the national plan needs to be followed for city planning, the practical city planning in Wuhan still serves for the local economic development. Future land use mainly depends on the value of the land and whether it can be developed.*"

- Brownfield redeveloper A (senior) from Wuhan

"*If the brownfields can be cleaned properly and supervised well, there should be no risk of residual contamination.*"

- Brownfield redeveloper A (senior) from Wuhan

"*A previous challenge is that the work of environmental protection and contamination management belongs to the environment protection agency, whereas the land use is under Ministry of Land Resources who plan the land use and functions. Accordingly, there is a debate whether the Ministry of Land Resources co-operate with the environment protection agency to consider brownfield redevelopment properly. In other words, the environment protection agency wants to set up plans for brownfield management, but the Ministry of Land Resources does not consider the plan in city planning, causing the failure in effective brownfield redevelopment.*"

-City planner A from Shenyang

"*When facing the case in which brownfields are planned to be redeveloped, the fact is that the composition and level of contaminants in brownfields are not the key factors affecting land use planning. Instead, local economic development plays vital roles in land use planning, particularly those brownfields to be redeveloped.*"

- Member A from third party from Guangzhou

Secondly, regarding the limited information about brownfield:

"*To what extent is the information sufficient. In other words, there is still not clear which type of information should be covered.*"

-City planner A from Shenyang

Lack of detailed information about brownfield:

"*There is a database for brownfield information, but not well established.*"

- Brownfield redeveloper A (senior) from Wuhan

"*For top decision makers, the current land use is well known, as well as the location and detailed information about brownfields. When the site has been contaminated by industries, it needs to be recorded and evaluated whether appropriate clean-up or remediation should take place.*"

- Brownfield redeveloper A (senior) from Wuhan

From one side, there is no sampling criterion for brownfield investigation.

"*Currently, there are only some discrete contamination data around brownfield or suspected land, and there is no precise map about the level and distribution of contaminants in brownfields.*"

-City planner A from Shenyang

"*There is lack of detailed soil survey data as reference for the following survey on brownfield. It is hard to map the area of potential brownfield.*"

-City planner A from Shenyang

"*Although there is no well-established benchmark and regulations for collecting brownfield information, we can start to build up the network based on current benchmark and regulations to go forward.*"

-City planner A from Shenyang

From the other side, it is difficult to build up brownfield information database.

"*Lack of sufficient man power, material and financial resources to obtain sufficient information of brownfield on the basis of current national soil surveys. It requires further management and plan for national soil survey, particularly those about industrial sites, like the current key industrial soil survey program.*"

-City planner A from Shenyang

"*How to set up long-term monitoring system to chase the soil quality after brownfields are remediated and redeveloped. It is important to ensure the remediation meets the target and there is minimal risk of human health.*"

-City planner A from Shenyang

"*During the city planning process, brownfield information (database) is required to be submitted and those without information needs further investigation and evaluation.*"

- Brownfield redeveloper A (senior) from Wuhan

Thirdly, investment for brownfield redevelopment is short:

"*Investment for brownfield redevelopment is usually provided by land owner, which are either previous land user or government (Land Reserve Center or Housing Construction Management Committee).*"

- Brownfield redeveloper A (senior) from Wuhan

As for how to improve brownfield redevelopment in the future, different participants gave respective answers from their own opinions.

"*We will consider brownfield redevelopment in city planning in the future, which is scheduled.*"

-City planner A from Shenyang

Brownfield redevelopment should also have a future view to achieve sustainable development.

"*Brownfield redevelopment should consider the current states of soil quality, and give a clear suggestion for the next 5-10 years.*"

-City planner A from Shenyang

Practices to improve brownfield redevelopment

"*The practical integral of city planning and brownfield redevelopment should rely on special plan combining land use and brownfield redevelopment, but the key point is the policies set by the government.*"

-City planner A from Shenyang

It is worth mentioning that a new approach has been released by the Chinese government, "multiple planning as one" (MPAO), which might be a solution to better consider brownfield redevelopment in the decision-making for city planning. MPAO is a good approach to integrate city planning and brownfield redevelopment.

"*Currently, a new mechanism of "multiple planning as one" (MPAO) can be a practical solution for this challenge to systematically and integrally apply land use planning, environment planning and others in city planning process.*"

-City planner A from Shenyang

"*Currently, MPAO has partially solved the problem (lack of spatial system representing both information for city planning and brownfield redevelopment) by systematically considering brownfield redevelopment during planning procedure, and fully take the layout, plan and solution together into account.*"

-City planner A from Shenyang

"*Current MPAO has combined four plans, including city master plan, land use master plan, economic plan and environment plan. The first two are managed by Ministry of Land Resources, and the third one is by National Development and Reform Commission (NDRC). However, it is not the best mode of MPAO.*"

-City planner A from Shenyang

"*With the new MPAO, environment protection agency is significantly more involved in decision making process by offering environment plan as the essential part. For example, the new 2020 city planning for the next 10-year city development must have the environment plan.*"

-City planner A from Shenyang

"*The combination of city planning and land use planning is poor in MPAO, and the corporation and negotiation are particularly inefficient in regional city planning.*"

- Member A from third party from Guangzhou

"*Guangzhou has attempted to use MPAO to integrate different plans, and they include city planning, land use planning, environment planning, agriculture planning, and economy planning. The advantage of the MPAO is that all the departments work not only individually but corporately to make decision. All the information is combined in one plan, which is shared by the departments for approval.*"

- Member A from third party from Guangzhou

Finally, the interviewees also offered several valuable suggestions on the practices which might improve city planning and brownfield redevelopment by integrating them in one achievable system.

"*For lands with strong restriction in environment plan, city planning cannot plan any future land use. For lands with special concerns in environment plan, city planning should full consider its potential risk and take appropriate strategies for potential development.*"

-City planner A from Shenyang

"*Brownfield redevelopers should be the key players during the brownfield redevelopment process, as both decision maker and the one managing the whole process. City planners are only participants to request data for city planning.*"

- Brownfield redeveloper A (senior) from Wuhan

"*Most of the decision makers believe the information about environment quality is sufficient, but the fact is only information of water and air quality is relatively sufficient (by both measurement and model prediction).*"

-City planner A from Shenyang

"*Ideally, government tends to listen more to the experts from the third party. The recent eco-civilization national strategy highlights the importance of industrial relocation based on the environment protection. For sustainable development and ecological environment protection, immediate economic benefits should be temporarily laid aside.*"

-City planner A (senior) from Wuhan

All the parties should work together to improve city planning and brownfield redevelopment. For mega city planning

"*Ideally, when the brownfields are considered in city planning for redevelopment, both city planners and brownfield redevelopers should share information and negotiate to decide their future land use or whether they should be redeveloped, instead of the decision from city planners only in the current situation. Currently, city planners only ask for advice from brownfield redevelopers about the contamination level, potential remediation strategies and management for brownfields.*"

- Brownfield redeveloper A (senior) from Wuhan

For regional planning

"*In regional planning, the layout and functions of planned sites should not be fixed in planning process when the sites are potentially contaminated. There should be a more flexible plan for their future land use to meet the requirement of brownfield remediation.*

In ideal city planning, both city planners and brownfield redeveloper are important in decision making process, more important than the third party."

- Brownfield redeveloper A (senior) from Wuhan

For specific brownfields, the three stakeholder groups (city planners, brownfield redevelopers and members from third party) work together to improve brownfield redevelopment. From the political point of view:

"*City planning should regard ecological civilization as priority.*"

- Brownfield redeveloper A (senior) from Wuhan

"*In the master planning process, environmental concerns should be fully considered for land resource redevelopment, including layout, function and infrastructure construction.*"

- Brownfield redeveloper A (senior) from Wuhan

"*Environmental challenges or problems, including brownfield redevelopment, should be considered during the city planning process, not to be adjusted after city planning.*"

- Brownfield redeveloper A (senior) from Wuhan

"*Brownfield redevelopment should not be a passive process. It should be part of the urbanization process, following the concept "Planning first and Eco-civilization priority" to achieve sustainable development, decrease in amount (brownfield) and increase in value (economy).*"

- Brownfield redeveloper A (senior) from Wuhan

For practical actions, brownfield redevelopers suggested:

"*For newly developed urban area, all the challenges should be systematically considered during planning process. As for old urban area, as there are many remaining problems and the pressure of economic development, all the aspects should be integrated for decision making to balance the economic development and ecological civilization. But ecological civilization should be placed in a more important place for intensive land use.*"

- Brownfield redeveloper A (senior) from Wuhan

6.8 Summary and discussion

Different from quantitative questionnaire with fixed questions, this chapter comprehensively discuss the current situation and driving forces for considering brownfield redevelopment in the decision-making process for city planning with open questions in qualitative interview. Generally, the results from the qualitative interviews are consistent with the questionnaire and further summarize the deeper understanding

of participants on the current situation and driving forces for considering brownfield redevelopment in the decision-making process for city planning. Additionally, several valuable suggestions are raised on the practices which might improve city planning and brownfield redevelopment by integrating them in one achievable system.

For the main purpose of city planning, most city planners suggest economic development as the priority, whereas brownfield redevelopers and members from third party think eco-civilization or an appropriate balance between economic development and eco-civilization is more important, consistent with the debates from multi-angle visions by some previous studies (Huan, 2016; de Jong, 2019). For this reason, city planners should consider more economic issues in the decision-making process for city planning and the involvement of brownfield redevelopers and members from third party is not sufficient in city planning (Loures and Vaz, 2018).

In the survey, all stakeholders agree that brownfield redevelopment is limited considered in the decision-making process for city planning, attributing to limited or even neglectable involvement of third party and brownfield redevelopers in city planning. From the political point of view, the main purpose of city planning still addresses the economic development, and how to introduce brownfield redevelopment as a complementary component in decision-making for city planning is a huge challenge to improve brownfield management and choose appropriate strategic framework in brownfield remediation (Burinskienė et al., 2017). As city planners, brownfield redevelopers and third parties have their respective viewpoints and interests during city planning process (Glumac et al., 2018), they are suggested collaborate in the decision-making process to avoid economic development as the only priority, but also urban ecology, humanistic harmony, etc.

Although ecological civilization is highlighted by the government, it is not well recognized by city planners that brownfield redevelopment is one of the key strategies to effectively reuse city area. Regarding the unsatisfactory consideration of brownfield redevelopment in city planning, most participants point out the main reason as the limited roles of brownfield redevelopers and third parties in either the city planning or brownfield redevelopment process, similar as the key challenges revealed by other researchers (Liu et al., 2017). To solve the problem, it is of great urgency to establish a new framework and strategy to involve city planners, brownfield redevelopers and members from third party as collaborators in city planning. Particularly for regional

planning which is dependent more on local situation, abandoned brownfields are always found in city area for redevelopment or reuse to improve the consideration of brownfield. For an ideal involvement and cooperation of all stakeholders in the decision-making for city planning, they should have an equal role.

Ideally, to consider brownfield redevelopment in city planning, both city planners and brownfield redevelopers should share information and negotiate to decide their future land use or whether they should be redeveloped. Brownfield database is not only a good platform for these two groups of stakeholders to understand the current brownfield information, but also a key component for the strategic framework considering brownfield redevelopment in city planning (Ahmad et al., 2018). However, there is lack of effective brownfield database in most Chinese cities. Currently, city planners only ask for advice from brownfield redevelopers about the contamination level, potential remediation strategies and management for brownfields. Brownfield survey targeting all the chemical industrial and abandoned sites at national level is therefore suggested to be conducted and construct the brownfield database for future land use (Moscovici et al., 2017). Considering the practical difficulties in establishing the brownfield database, such as access to on-going factories and the lists of priority contaminants for each industry to be validated, future work should be well organized.

It is concluded from the survey that the current decision-making process for city planning suffers from the multiple revisions, which is time and resource consumption and hardly considers brownfield redevelopment during city planning process. As in China, land use is under MLR planning the land use and functions, it is necessary for local MLR to cooperate with MEE, the environment protection agency responsible for of environmental protection and contamination management issues, and consider brownfield redevelopment properly with city planners. Accordingly, plans from different government departments should be properly integrated for effective management (Feng et al., 2018). In this survey, MPAO is suggested as a new approach released by the Chinese government to better consider brownfield redevelopment in the decision-making for city planning. MPAO is a good approach to integrate city planning and brownfield redevelopment. Current, it has combined four plans, including city master plan, land use master plan, economic plan and environment plan. The future strategic framework will take more plans released by other departments and integrate them into upgraded system as suggested by MPAO.

Investment for brownfield redevelopment is also pointed out by several participants for effective brownfield redevelopment. Currently, investment for brownfield redevelopment is usually provided by land owners, which are either previous land user or government (Han et al., 2018). In fact, it has been raised by many researchers that investment is a critical factor in brownfield redevelopment across China, as a huge amount of capital is required for brownfield evaluation and re-development in the near future (Kotval-K, 2016; Ahmad et al., 2019b).

7. Suggestions for improved decision-making

7.1 Introduction

The challenges of brownfield redevelopment in China are mainly derived from the serious contamination arising from historical industrial activities and demands of land use during the rapid urbanization process. Currently, China is facing a specific development stage of 'extensive development mode' and lack of effective environmental supervision' in the process of industrialization and urbanisation. Accordingly, Chinese brownfield manangement and redevelopment is still at an early stage.

This study identified various challenges, including:

- limited consideration of brownfield redevelopment in the decision-making process for city planning;
- multiple planning systems;
- lack of brownfield databases to help prioritise and guide appropriate management;
- unclear division of responsibility between stakeholder groups;
- insufficient involvement of city planners in brownfield redevelopment, and
- limited awareness and participation of the public.

Some similar critical challengs or barriers have been partially rasied in some developing countries, such as Pakistan (Ahmad et al., 2019a) and the Czech Republic (Klusacek et al., 2018). To overcome these problems, some suggestions are offered in this chapter, as to how to better consider brownfield re-development in the decision-making process for city planning, namely:

1) setting a new regulation framework for effective decision-making for city planning and appropriate consideration of brownfield;

2) recruiting professional groups of city planning and brownfield redevelopment experts to offer advice;

3) establishing databases for brownfield management and redevelopment;

4) demonstrating case studies from western countries and in China to evaluate the appropriate practices;

5) promoting involvement of brownfield redevelopers and members of third parties in the decision-making process for city planning;

6) encouraging public awareness and involvement in city planning process.

7.2 New regulation framework for effective decision-making for city planning and appropriate consideration of brownfield

The issue of brownfield site management has received national attention in China. The former MEP (now MEE) has taken the dominant responsibilty and has issued a series of environmental risk management and control policies. As early as 2004, the former MEP (now MEE) promulgated the 'Notice on Effectively Preventing and Controlling Environmental Pollution during the Process of Enterprise Relocation' (Environmental Office〔2004〕No. 47). In November 2012, the former MEP (now MEE), the Ministry of Industry and Information Technology (MIIT), the MLR and the Ministry of Housing and Urban-Rural Development (MHURD) jointly issued the 'Notice on Safeguarding the Environmental Safety of Redevelopment and Utilization of Industrial Enterprises (Huanfa〔2012〕No. 140)'. In 2013, the General Office of the State Council issued the 'Notice on the Recent Work on Soil Environmental Protection and Comprehensive Management (Guo Ban Fa〔2013〕No. 7)', clearly stating that it is necessary to strictly control soil pollution and strengthen the environmental risk control of contaminated soil. This has made soil environmental protection and comprehensive management a special action to be implemented and supervised on the national level. In May 2014, former MEP (now MEE) issued the 'Notice on Strengthening the Prevention and Control of Pollution in the Process of Shut Down, Relocation of Industrial Enterprises and Redevelopment of Original Sites' (Huanfa〔2014〕No. 66), further emphasising the importance of prevention and control of brownfields, as well as enviromental risk management.

In May 2016, the State Council issued the 'Notice on the Action Plan for Soil Pollution Prevention and Control (Guo Fa〔2016〕No. 31)' which proposed the implementation of sub-categories, sub-uses, and phased management with the core of improving the quality of the soil environment. This 'Notice' aims at controlling new pollution, gradually reducing stocks and forming the overall requirements of soil pollution prevention and control systems. This consists of government-leading role, enterprise

responsibility, public participation and social supervision. At the same time, the 'Notice' explicitly proposed ten major strategies for land pollution prevention and control, including the implementation of soil pollution surveys, promotion of soil pollution prevention legislation, management of construction land access, pollution control and remediation, etc, thus, this 'Notice' was also referred to as the 'Soil Ten'.

The introduction of 'Soil Ten' means that China's response to brownfields has gradually switched from prevention and management to the post-remediation stage of redevelopment, and has proposed the responsibility of the land and planning departments in soil pollution prevention and control. This 'Notice' proposes strict measures of land access, requiring soil environmental management of construction land and soil environmental risks to be included in urban planning and land management system at all levels. In addition, land development and utilization must meet requirements of soil environmental quality. This means that environmental risks of contaminated land and rational utilization of it should be fully considered when local departments of land and resources, urban and rural planning and other departments at all levels make out land use overall planning, urban master planning, control detailed planning and other related planning.

However, the planning and land departments have not fully met the requirements of soil environmental regulation by the environmental protection department. In November 2016, MLR responded to this request and issued the 'Guiding Opinions on Deepening the Redevelopment of Urban Low-Efficient Lands (Trial)', which stipulated that several types of previously unavailable land could be included in the scope of reformable and developable land. These types of land cover prohibited and eliminated industrial land stipulated by the national industrial policy, land out of reach of requirements for safety production and environmental protection, 'returning two into three' industrial land, etc. The 'Opinions' also proposed to coordinate the urban function redesigning, industrial structure adjustment, and ecological environment protection in the process of preparing planning for renewal and transformation of low-efficiency land. Though the 'Opinions' put forward that the environmental risk control of brownfield should be combined with planning and regulation, detailed implementational guidance and requests are still not clear, such as the way to control the contaminated land, specific procedures and technical requrirements.

In order to implement 'Soil Ten' comprehensively, in 2016-2017, Guangdong, Zhejiang,

Hainan, Fujian and Sichuan provinces have successively issued the 'Implementation Plan for Soil Pollution Prevention and Control Action Plan' (IPSPPCAP). IPSPPCAP of Guangdong Province, as an example, deepens the construction land access management system that is linked to the national land planning. Firstly, the 'Plan' clears management of sub-use: land parcels that meet the requirements for soil environmental quality of the corresponding planned land can be used as land use procedures; for land beyond the reach of requirements, corresponding planning should be adjusted, or remediation should be operated to reach the standard in order to enter the land use procedures. Secondly, the 'Plan' incorporates the soil environmental management requirements for construction land into urban planning and land management, which means that land development and utilization must meet the requirements of soil environmental quality. When preparing the overall land use planning, the land and resources departments at all levels should fully consider the soil environmental risks of the contaminated land, rationally plan the land use, strict construction land approval, and strengthen the supervision and management in the process of land expropriation, recall, acquisition, transfer and change of use on the basis of the soil environmental quality.

Afterwards, Shanghai and Guangzhou also issued the 'Implementation Plan'. Phased work objectives have been formulated from a thorough investigation of soil quality and classification control to the assurance of soil environmental safety, comprehensive control of soil environmental risks, to overall improvement of soil environmental quality. At the same time, the relevant division of responsibilities of the city's municipal departments is clearly defined, including not only the environmental monitoring and inspection work related to the environmental protection department, but also the controls and requirements of the land planning department for the soil environmental risks in the land planning, application, and the use stage. The 'Implementation Plan' of Shanghai also proposes to strengthen urban and rural planning demonstration and approval management for the redevelopment and utilization of contaminated sites on the basis of soil and groundwater environmental quality status. Specifically, Shanghai takes groundwater environmental quality into consideration and proposes to establish a negative list of redevelopment and utilization of contaminated sites to rationally determine the land use.

A further important recent development is the re-structuring of Government Ministries

by the central Gvernment, with the creation of the MEE in 2018. It superseded the former MEP. There are opportunities, as a result, to strengthen the management and control of brownfield sites.

7.3 Database for brownfield management and redevelopment

Lack of brownfield information is viewed by most participants, in either questionnaire or interview, as the key challenge restricting the consideration of brownfield redevelopment in the decision-making process for city planning in China. As brownfield registration is affected by rapid land use change, poor tax record and concealing information from land owners to reduce cost, there is still no well-established database of brownfields in Chinese cities, challenging the consideration of brownfield redevelopment in the decision-making for city planning.

Considering the information required for effective site management, such as the risk level and the social attention, the brownfield database needs to be established for priority management and risk control. All localities should establish a list of (potentially) contaminated land and a negative list for development and utilization of land with dynamic updates based on results of the soil investigation of the construction land, combined with the list of potential polluted land and the environmental risks of contaminated sites. For those where environmental accidents once occurred and had a significant impact on the health of the surrounding population or social stability, or industrial sites that exist and were heavily contaminated, the local government can directly include them into the priority management list. Hepburn et al. (2019) suggested a decision support system as the framework for applying a similar participatory evaluation process to assess the groundwater decontamination for city development (Hepburn et al., 2019). From their work, environmental datasets to be collected and managed can significantly contribute to the inter-disciplinary collaborations to drive improvements in brownfield redevelopment which helps further land re-use and city planning.

Land that meets the soil quality requirements of the corresponding planning process can enter the land use procedure, or else, its corresponding planning should be adjusted, or remediation should be operated to reach the required standard needed to enter the land use procedures. For contaminated sites that will not be exploited or do not have the conditions for remediation, the local government should then organize the demarcation

of the control area, set up signs, issue announcements, and carry out monitoring of soil, surface water, groundwater and air environment. The relevant responsible party should then adopt environmental risk control measures, such as segregation and blocking of pollutants when they are found diffusing.

Considering the practices for considering the brownfield redevelopment in the decision-making process for city planning and effectively manage brownfields, an appropriate brownfield database is urgently required and its management is critical. At regional level, both the MLR and city planners should raise programs in for collecting and updating brownfield information, during either the brownfield survey project for abandoned sites or the city planning process for sites to be redeveloped. A national brownfield database is also suggested for central government to guide brownfield redevelopment along the city planning process, and a national supervision system should be proposed to monitor the information update of brownfield across cities and evaluate brownfield redevelopment in the decision-making for city planning. Additionally, regular management of the brownfield database is important; the responsibility of the brownfield database needs to be clarified for its effective management. The brownfield database serves not only as a reference to check the location and status of brownfield sites, but also a component of brownfield altering system. A three-tier alerting system is proposed and brownfield database can help in setting targets for: 1) consideration of brownfield redevelopment in city planning, 2) whether the city plan appropriately considers brownfield information in its decision-making process, 3) appropriate remediation and risk control strategy for brownfield management.

7.4 Promoting involvement of brownfield redevelopers and members of third parties in the decision-making process for city planning

Under the unified arrangement of the state council, the provinces and some cities have successfully set up leading groups to coordinate the promotion of brownfield pollution prevention and control. By strengthening organizational leadership and the linkage between environmental protection and land planning, the role of planning and land management in brownfield environmental management has gradually emerged. In the upper-level organization structure, the environmental protection department should be the leading department of the brownfield control, while as for the planning and

management organization, the main body of responsibility for the brownfield environmental risk has not been clarified, which can be solved by establishment of an independent brownfield redevelopment coordinating department or setting up an environmental control office in the planning department. All localities and relevant departments should strengthen coordination and cooperation to achieve joint supervision, share information, and realize the prevention and control of soil pollution. This finding is consistent with Yuan's idea that communication and collaboration need to be well established to deal with the environment-related issues in city planning or redevelopment process (Yuan, 2019).

The Urban Planning Committee, as the key body for urban planning decisions of the municipal government, reviews the major issues of urban planning and construction. Because soil environmental assessment and management involved in brownfield planning requires professional expertise, the supervision mechanism of relevant professionals is suggested in the existing Urban Planning Committee system, including the addition of a brownfield planning expert pool and members of third party (Figure 8.1). For projects involving brownfield planning, it is necessary to ensure that environmental experts participate in the deliberation and improve the decision-making of the environmental protection department. The opinions of the Urban Planning Committee shall be implemented by the organization and planning department, in coordination with the environmental protection department. Soil environmental assessment work should be carried out simultaneously in the planning preparation stage. but failing to carry out relevant work, it shall be reviewed after the implementation of the soil environmental assessment and treatment plan. It is worth mentioning that the proposed structure and involvement of the urban planning committee system for the consideration of brownfield redevelopment in the decision-making process for city planning contains four featured changes. Firstly, city planners, brownfield redevelopers and members from third party form a complicated nexus in the committee, in which frequent contacts and interactions are institutionally organized for their sufficient exchange brownfield information and city planning. Secondly, the nexus is organized by experts for city planning and brownfield redevelopment, and they can provide sufficient experience and technical training for the general office to ensure auditing. Thirdly, city planners lead the land planning department and their participation in urban planing committee system helps in their effective involvement in the practical decision-

making process for city planning. Finally, members from third party have strong interactions with municipal provincial county office for many other social issues, and it is easier for them to improve their awareness of brownfield redevelopment during city planning process.

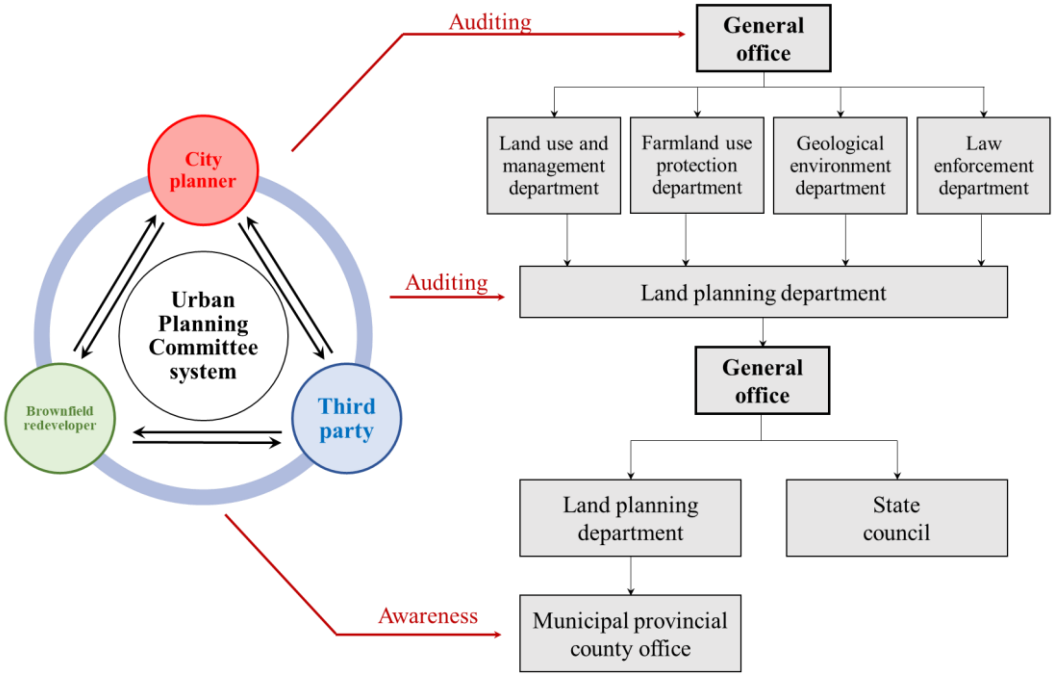


Figure 8.1 Suggested structure of the urban planning committee system for effectively considering brownfield redevelopment in the decision-making process for city planning. New features of the proposed structure and activities include: 1) close connection with the nexus of city planners, brownfield redevelopers and members from third party to form the committee, 2) experience of both city planners and brownfield redevelopers for auditing general office, 3) leadership of city planners in land planning department to ensure the auditing, 4) contributiong of strong interactions between members from third party and municipal provincial county office to promote their awareness during the deicision-making process for city planning.

From the general process of land development and brownfield redevelopment in China (Figure 2.7), a new decision-making process for city planning is therefore recommended to consider brownfield redevelopment properly in the new system, as illustrated in Figure 8.2. Comparing to Figure 2.7, the proposed decision-making process introduces an urban planning committee, which include city planners, brownfield redevelopers and members from third party, as a key member involved in the first trail and auditing steps. Different from other departments, the major roles of the urban planning committee in

this process is to fully consider whether and how to address brownfield redevelopment for city planning, by evaluating the land history, checking the list of brownfields, reviewing the status of brownfields to be planned, and assessing the potential risks in each brownfield.

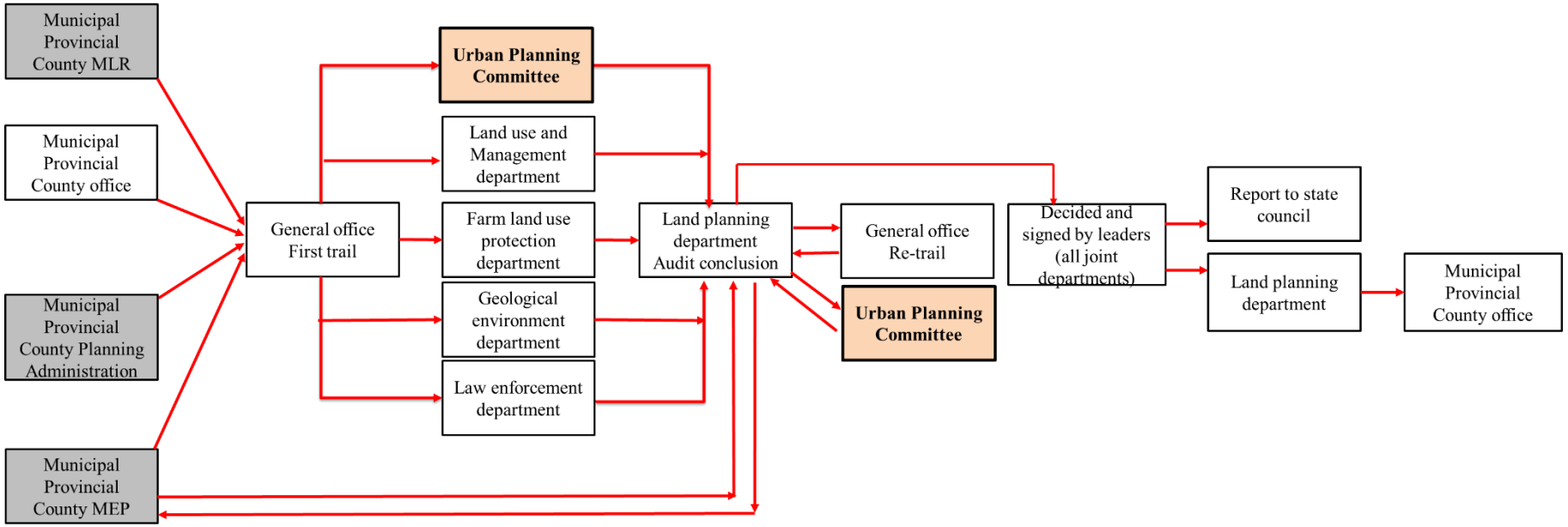


Figure 8.2 Suggested decision-making process for city planning and land development to consider brownfield redevelopment. Comparing to current decision-making process (Figure 2.7), the proposed one introduces urban planning committee (the nexus of city planners, brownfield redevelopers and members from third party) in the second step (after first trail by general office) and second step (audit conclusion by land planningdepartment) of decision-making for city planning to ensure sufficient consideration of brownfield redevelopment in city planning.

In such a new process, the activities for land use (either clean land or brownfield) should be altered, compared to the current activities in Figure 2.8. A initial step of "land survey and risk assessment" is proposed before "prepare general land use plan", as this step aims to identify potential contamination and hazards at the targeted sites. Subsequently, for clean sites, the following activities follow the same scheme as the current activities, whereas "action plan" is an extra step for brownfield. Its roles are to determine strategies for brownfield remediation and risk control, and then brownfields follows the similar activities as clean fields, except for extra and careful consideration of its future functions.

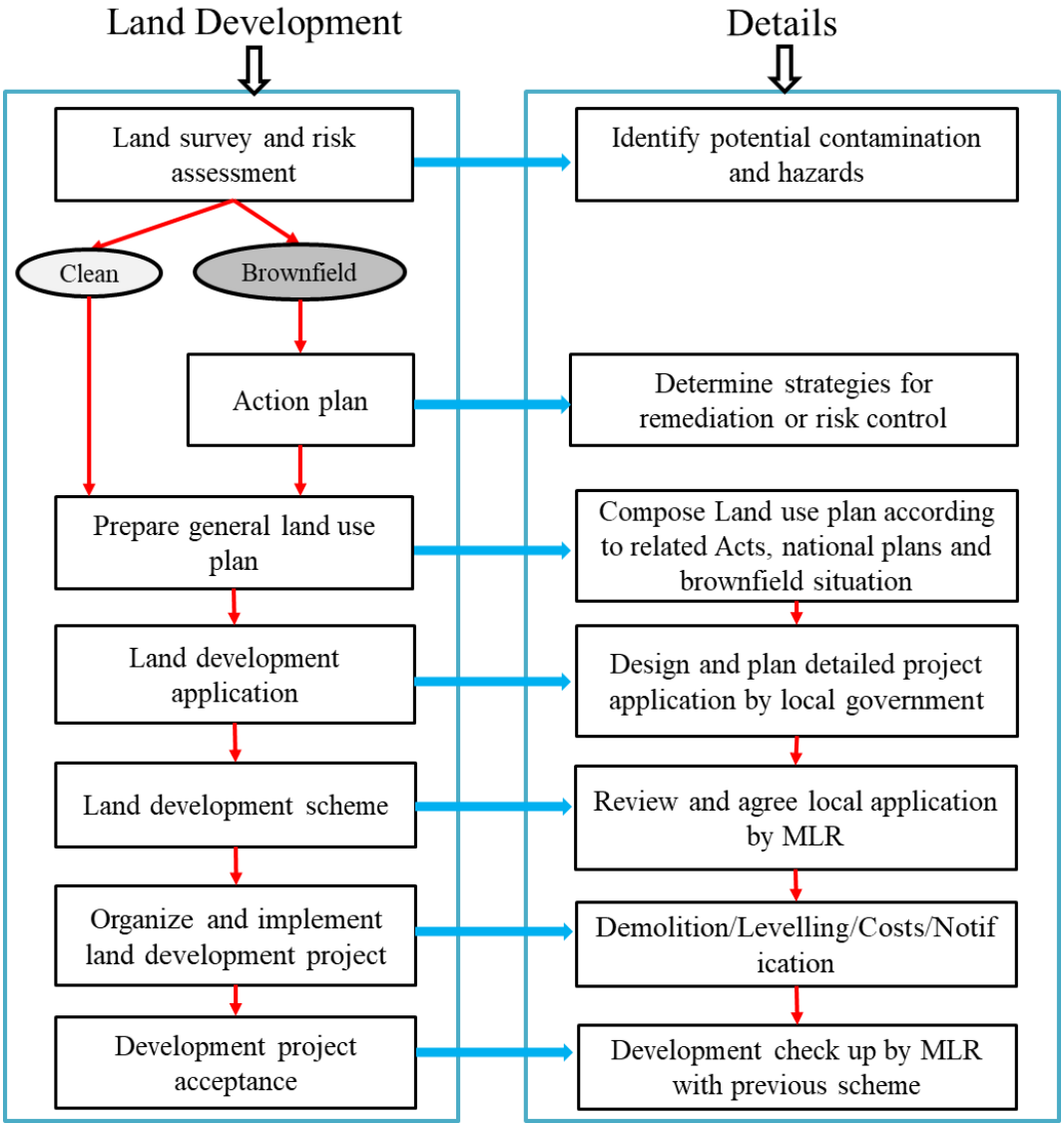


Figure 8.3 Extra activities in land use for considering brownfield redevelopment in the decision-making process for city planning.

As mentioned above, with more involvement of brownfield redevelopers and members from third party, they together with city planners should be considered in an ideal model to improve brownfield management along with city planning. From the results in this study, city planners, brownfield redevelopers and members from third parties are all expected participants responsible for and involved in the decision-making process for city planning. To set up effective brownfield management strategies, the ideal three-level decision-making framework for considering brownfield redevelopment in the decision-making process for city planning (Figure 8.4) should include the following appropriate steps:

- Brownfield redevelopers will be involved in the decision-making process for city planning to help in making the decisions on the functions of targeted sites, which is directly linked to the remediation target.
- City planners and brownfield redevelopers will set up the reasonable remediation target and decide the remediation budget according to national standards and guidelines.
- Based on site function and remediation target/budget, brownfield redevelopers make the decisions on appropriate remediation approaches for brownfield redevelopment.

The three levels of decision-making framework are potentially an improved approach to encourage the participation of brownfield managers and other relevant authorities in city planning. It helps the central or local government with reasonable scientific decision-making in brownfield redevelopment. Similarly, a participatory evaluation process has recently been developed for effective brownfield redevelopment in France (Tendero and Plottu, 2019), which suggests that a participatory process can ensure that feasible, coherent, and transparent choices are made in the decision-making process for city planning.

As different stakeholder groups have their respective roles and activities, they should be encouraged in distinct ways in the decision-making framework for city planning. City planners lead the decision-making process for city planning and should consider whether the site is contaminated or not before preparing the general plan. In the three-level decision-making framework, city planners propose the city plan and encourage the involvement of brownfield redevelopers and members from third party. For

brownfield redevelopers, they start the involvement by providing the brownfield database and raise appropriate suggestions for the potential functions of brownfield to be developed. Additionally, brownfield redevelopers prepare different scenarios of city planning and remediation approaches for all the brownfields considered in the city plan, and evaluate their feasibility from a brownfield management perspective. Brownfield redevelopers might also have roles in improving the qualifications of city planners and strengthening the awareness of the public. Members of third parties contribute to each step of such decision-making process as consultants to ensure the involvement of the public and the participation of brownfield redevelopers in the decision-making process for city planning.

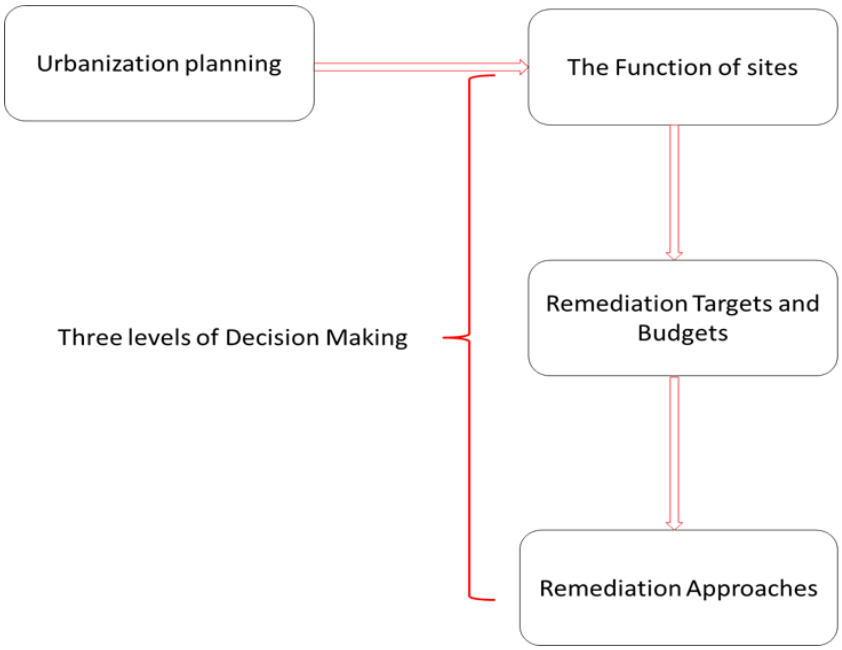


Figure 8.4 Three levels of decision-making for city planning.

7.5 Encouraging public awareness and involvement in the city planning process

During the stage of plan implementation and brownfield management, viable brownfield remediation strategies and environmental protection supervision mechanisms should be established to ensure that the preparation and review of the soil pollution environment investigation and risk assessment report are carried out in a timely manner. Remediation plans and responsible parties need to be cleared and brownfield remediation should be finished before the alteration of land user and approval of planned land permit, according to the final evaluation. It is also important to improve the supervision and acceptance system. A public-private partnership

approach has been recently raised in China for addressing brownfield remediation problems. This reaches a similar conclusion to this study, namely that the consideration of brownfield redevelopment for city planning should be fully addressed in future city development for the unique urbanization characteristics in China and the involvement of the public and private sectors, members from third party in this study, should be encouraged by both city planners and brownfield redevelopers (Han et al., 2019).

In the stage of public participation, a brownfield information disclosure and social supervision system is supposed to be established. It is necessary to strengthen the public's understanding of the seriousness of brownfield pollution from social and media channels, and to enhance the common sense, awareness and concern of the society. At the same time, the planning department should also disclose information on soil pollution and other environmental pollution as much as possible in the planning publicity for reference and supervision by the public, in order to raise public awareness and promote their participation in polluted land management. However, the public might have many interests regarding different aspects in city planning. Their focus on brownfield redevelopment is limited. Therefore, the public may raise many concerns and suggestions, which are not always helpful for considering brownfield redevelopment. To solve this problem, three suggestions are made. Firstly, the brownfield database should be available for the public to improve their awareness. In this way, members from third parties will have a clear vision on the current situation of brownfields across regions and successful cases effectively considering brownfield in city planning. Thus, they have more awareness of the importance and necessity of brownfield issue and can provide suggestions and target comments during their involvement in decision-making for city planning. Secondly, during the process of collecting the public’s suggestions, brownfield redevelopment is a must-choose option and all the members from third party are forced to carefully consider all the possible information of brownfield and consequences after brownfield redevelopment. Finally, a mechanism is proposed to include the representatives of the public or members from third parties as the expert board members for consultancy in city planning and brownfield redevelopment. They should be responsible for their suggestions during city planning and brownfield redevelopment process.

8. Conclusions and recommendations

8.1 Conclusions

Chinese industrial reconstruction and rapid urbanization processes in the last decades have left more industrial sites to be redeveloped and some of them are brownfields. Brownfield redevelopment therefore has become an emergent issue for city sustainable development. A critical review of the current decision-making process for city planning and the consideration of brownfield redevelopment in the decision-making process for city planning in China shows a strong link between city planning and brownfield redevelopment. Challenges in considering brownfield redevelopment in the city planning process in China are identified, including the rapid urbanization process and the short decision-making process, lack of adequate monitoring or complete legislation systems, huge numbers of brownfield sites but incomplete information about them. Accordingly, a deeper understanding of the relationship between city planning and brownfield redevelopment in China and the driving forces affecting such relationships can help in optimizing the current regulatory system and offering potential strategies to improve brownfield redevelopment during the city planning process. For this purpose, this research sets the following objectives as:

1) to understand the current and changing decision-making process during city planning in China;

2) to understand the extent and how brownfield redevelopment is considered in the decision-making process for city planning;

3) to identify different decision-making process for city planning in different cities;

4) to compare brownfield management strategies between Chinese and western cities;
5) to develop and suggest novel systematic scheme for industrial brownfield redevelopment pertaining to the decision-making process for city planning.

Additionally, this study hypothesizes that the decision-making process for city planning can significantly affect brownfield redevelopment, but there is limited knowledge about the factors influencing brownfield redevelopment during the decision-making process for city planning.

To test these hypotheses and achieve the research objectives, both quantitative questionnaires and qualitative interviews were carried out to obtain enough information.

Before conducting a large formal survey, a pilot survey was conducted to test the viability of question sheets and to design questions for both the questionnaire and the interview. The formal survey was carried out from March-June 2018, to collect data from participants from three major cities with different settings and backgrounds (Shenyang, Wuhan, Guangzhou) and three typical stakeholder groups (city planners, brownfield redevelopers, members from third party). In the formal survey, a questionnaire was designed to obtain some basic information about the research questions and hypotheses, and a face-to-face interview with open questions was carried out to collect the detailed information about driving forces and influential factors.

Of the 196 participants taking the formal survey, their distribution between the cities and stakeholder groups was similar. Reliability tests and validity tests proved the quality and accuracy of the survey. A total of 66 participants then took the qualitative interview, with longer and more productive interviews conducted with 21 participants.

Results from the quantitative questionnaire showed that the current and changing decision-making process during city planning in China (**research objective 1**) is uncovered and linked with brownfield redevelopment. Besides the classic decision-making process, policy makers have strong power in city planning owing to the short decision-making process in China. It therefore significantly affects the consideration of brownfield redevelopment during decision-making process for city planning. Particularly, brownfield redevelopers and members of third party agree that there is a strong correlation between city planning and brownfield redevelopment. Additionally, the statistical analysis of all participants helps in understanding the extent and how brownfield redevelopment is considered in the decision-making process for city planning (**research objective 2**). Generally, city planners, brownfield redevelopers and members from third party have different opinions towards the roles of different stakeholder groups in the decision-making process for either city planning or brownfield redevelopment. City planners regard the city plan as the main driving force for brownfield redevelopment, whereas brownfield redevelopers and members of third parties view sustainable development as the key driving force. City planners have limited understanding on brownfield redevelopment and underestimate the roles of brownfield redevelopers in city planning process, whereas brownfield redevelopers and members of third parties hold the opposite opinion. Additionally, there is a similar decision-making process for city planning in different Chinese cities (**research**

objective 3), but the driving forces vary. Participants from Guangzhou, which has a higher economic development level, regard economic development and the city plan as more important driving forces than others; participants from Shenyang and Wuhan prefer more involvement of brownfield redevelopers.

Qualitative interview results were consistent with the questionnaire and present a deeper understanding of participants on the current situation and driving forces for considering brownfield redevelopment in the decision-making process for city planning. Most participants realized the limited roles of brownfield redevelopers and third party in either city planning and brownfield redevelopment process, and pointed out that improving involvement of brownfield redevelopers in the decision-making process for city planning is an effective approach for better design of the city plan and sustainable brownfield redevelopment.

Overall, the findings in this study suggested that current urbanization and city planning in China is at the stage of 'extensive development mode' with a lack of effective environmental supervision. By comparing brownfield management strategies between Chinese and western cities (**research objective 4**), this study discusses many challenges in brownfield redevelopment in China, and there is limited consideration of brownfield redevelopment in the decision-making process for city planning. It is caused by the multiple planning systems and lack of brownfield databases. Moreover, there is unclear division of responsibility between stakeholder groups, i.e., insufficient involvement of brownfield redevelopers in city planning, limited awareness and participation of the public. To better consider brownfield redevelopment in city planning, a novel systematic scheme for industrial brownfield redevelopment pertaining to the decision-making process for city planning (**research objective 5**) is suggested, including new decision-making regulation frameworks and brownfield databases. Additionally, mechanisms need to be established to promote and encourage the involvement of brownfield redevelopers, third parties and the public in the decision-making process for city planning.

8.2 Limitations of the project

Although this study was carefully designed, to target the research questions and objectives and test the hypotheses, there are still some limitations restricting the findings and conclusions of this work.

First, a pilot study was conducted to help design/test the approach for the questionnaire and interview. However, the number of participants was limited and the pilot study only lasted for 3 months. Accordingly, some key factors affecting the consideration of brownfield redevelopment in the decision-making process for city planning were therefore probably missing in the full formal survey, as identified after analyzing the survey data. For example, some participants pointed out that the government's remediation budget is different across cities, which significantly affects the decision-making process for city planning and city planners tend to ignore brownfield issues in cases where there is a limited remediation budget. Another potential influential factor raised by some members from third parties was that "multiple planning as one" is a good solution to encourage the consideration of brownfield redevelopment in the decision-making process for city planning. However, this was not mentioned in either the questionnaire or interview.

Secondly, the number of participants was somewhat limited, owing to the restricted time for the survey (6 months). Although 196 participants took the formal survey, they were categorized into three groups, in terms of either their stakeholder group or city. Thus, only ~50-80 participants fall in each group. From a statistical point of view, this number is acceptable, but a longer survey lasting 12-18 months would have collected more data from a higher number of participants.

Thirdly, only three cities were included; two of the mega cities in China (Beijing and Shanghai) were not considered, owing to the political risks and industrial history as mentioned in Chapter 3. Although these three cities can represent the classic types of Chinese cities and cover the three main categories, more cities should be addressed to obtain more cases, particularly for those second- or third-tier cities which have their own characteristics and regional-specific influential factors.

Finally, since the release of the Chinese Governments "Soil Ten", more regulations and standards relating to brownfield redevelopment were released in the last five years in China. Even during the survey process, some newly released regulations brought new situations regarding policies, regulatory frameworks, management systems of city planning and brownfield redevelopment. Some findings in this study can only reflect the information at that time, during a dynamic period of change. A good example is the national soil quality survey, initiated in 2016 and completed in 2018, targeting the soil quality in many brownfields, and the database of brownfield information which is being

set up in some demonstration areas and will be optimized by the end of 2020.

8.3 Future work

Future work is suggested to further understand the relationship between city planning and brownfield redevelopment in China and then implement the consideration of brownfield redevelopment in the decision-making process for city planning.

First, a revisit to the same groups of participants is suggested for future works to call for their feedbacks. The first reason for doing this is to ask their advice on the results and analysis, whether the main findings and conclusions are appropriate or how can they be modified. From their suggestions, the outcome of this work can be significantly improved, particularly for the systematic scheme for industrial brownfield redevelopment pertaining to the decision-making process for city planning, which might be more practical for future consideration. Secondly, they might have some suggestions derived from this work and raise new solutions to improve the current management system and the consideration of brownfield redevelopment in the decision-making process for city planning. These outcomes can lead to new concepts or elements in the systematic scheme for industrial brownfield redevelopment pertaining to the decision-making process for city planning, making it more suitable to fit well with the current decision-making framework. Also, it will raise clues for the design of further study to address the practical activities for improving brownfield redevelopment in city planning and evaluating the effectiveness of each solution.

Additionally, from the suggested solutions in this study, some practical work should be raised. For instance, although the database of brownfield information has been planned by the State Council, how to effectively collect the data, analyze contamination level in brownfields and manage the database still challenge the governmental officers. It is important to design routine strategies and help different stakeholders in participating in the new regulatory system. Additionally, practices to encourage the involvement of the public in either brownfield redevelopment or city planning should be efficiently released and supervised in the urban planning committee system.

Finally, this study mainly focuses on the theoretical aspect of considering brownfield redevelopment in the decision-making process in China. Some empirical study approaches, such as scenario building and case studies, are strongly recommended. As both brownfield redevelopment and city planning are empirical activities to target the

future use of contaminated or clean fields, empirical study methods can help in identifying the practical solutions.

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Appendices

Appendix 1. Soil contamination in the UK.

Table S1. Summary statistics for selected total element concentrations in surface soils (0.20 m) in 14 UK urban areas.

City	Count	As (mg/kg)			Cd (mg/kg)			Cr (mg/kg)			Ni (mg/kg)			Pb (mg/kg)			Hg (mg/kg)			Se (mg/kg)		
		Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Cardiff	508	6	150	16	0.50	82	1	1	2426	72	9	476	26	14	7575	76	nd	nd	nd	nd	nd	nd
Doncaster	279	2	74	13	0.50	7	1.0	21	499	64	5	163	19	18	1100	78	nd	nd	nd	nd	nd	nd
Glasgow	1381	1	283	9	0.25	16	0.3	38	4286	108	6	1038	47	13	5001	127	nd	nd	nd	0.20	14.5	0.9
Hull	411	3	205	20	0.35	5	0.4	22	1809	83	6	1123	39	10	2900	116	nd	nd	nd	nd	nd	nd
Lincoln	216	4	65	11	0.45	5	0.4	19	260	43	2	101	14	15	1400	55	nd	nd	nd	nd	nd	nd
Manchester	300	2	1001	20	0.25	80	0.9	30	1238	76	4	148	29	20	2758	218	nd	nd	nd	0.05	3.2	0.4
Mansfield	257	3	71	11	0.35	9	1.0	18	250	54	4	102	16	1	1319	76	nd	nd	nd	nd	nd	nd
Scunthorpe	196	3	190	19	0.45	28	1.0	7	1108	55	1	202	15	9	3300	45	nd	nd	nd	nd	nd	nd
Sheffield	575	4	239	22	0.35	8	1.0	43	1251	102	8	473	32	19	4300	164	nd	nd	nd	nd	nd	nd
Stoke	747	2	136	14	0.40	43	2.0	22	441	73	5	124	23	10	4208	93	0.005	7.22	0.14	nd	nd	nd
Swansea	373	8	2047	53	1.00	61	2.0	20	565	74	8	349	37	20	14714	225	nd	nd	nd	nd	nd	nd
Telford	294	5	54	10	0.50	30	1.0	25	164	65	7	153	28	20	1236	92	nd	nd	nd	nd	nd	nd
Wolverhampton	285	4	157	17	0.00	70	1.0	39	1297	95	12	264	33	27	2853	158	nd	nd	nd	0.00	4.0	1.0
York	191	3	93	10	0.35	9	1.0	27	639	59	6	84	19	24	2400	106	nd	nd	nd	nd	nd	nd
National	5692	nd			0.7			39			22			40			nd			nd		
UK 'Typical' soil guideline values (SGV) in dry weight soil (mg/kg)																						
Residential with plant uptake		20			1 (pH 6) 2 (pH 7) 8 (pH 8)			130			50			450			8			35		
Residential no plant uptake		20			30			200			75			450			15			260		
Allotments		20			1 (pH 6) 2 (pH 7) 8 (pH 8)			130			50			450			8			35		
Commercial/ Industrial		500			1400			5000			5000			750			480			8000		

- National=National Soil Inventory of England and Wales (McGrath & Loveland 1992) aqua regia digest (0.15 m).
- Min: minimal concentration. Max: maximal concentration. Med: median concentration.
- nd=No data.
- Typical soil guideline values (SGV) derived from the UK CLEA contaminated land assessment model (DEFRA–EA 2002b).

Appendix 2. Soil contamination in China.

Table S2. Concentrations of heavy metals in urban soils in the cities from China (mg/kg).

City	Cr	Cu	Pb	Zn	Ni	Cd
Beijing	36	24	29	66	28	0.15
Changchun	-	42	55	110	74	2.9
Taicang	64	32	18	92	30	0.11
Fuyang	-	41	41	160	22	0.37
Guangzhou	-	63	109	169	26	0.5
Hangzhou	48	41	76	148	24	1.3
Luoyang	71	85	66	216	-	1.7
Nanjing	85	66	107	163	-	-
Shanghai	108	59	77	301	31	0.52
Wenzhou	-	35	65	169	-	-
Changsha	121	51	89	276	-	6.9
Xiangtan	84	38	65	127	-	0.46
Zhangzhou	30	33	76	107	13	0.35
Shenyang	-	209	470	600	-	8.6
Hongkong	23	23	95	125	12	0.62
Qingdao	54	55	62	201	17	0.3
Baoji	102	112	25381	1964	72	-
Jinchang	195	1226	40.3	118	910	1.11
Shenzhen	-	28	54	73		0.39
Xuzhou	78	38	43	144	34	0.54
Range	23-194	23-1226	29-25381	66-1964	12-910	0.15-8.6
Mean	78	115	1351	266	99	1.6
China soil background	61	23	26	100	27	0.097

Appendix 3. Responses to quantitative questionnaire of individual participants

Table S3-1. Responses to quantitative questionnaire of individual participant (city planners from Shenyang city).

City and stakeholder		**Shenyang city**																
		City planners																
Questions		**Selections**																
1	**1-1**	2	2	1	1	1	1	1	2	1	2	1	1	2	2	1	2	2
	1-2	1	2	2	2	1	2	1	2	1	3	2	2	2	2	2	2	2
	1-3	1	1	1	1	1	2	1	1	1	2	2	2	1	1	1	1	1
	1-4	1	1	2	1	1	2	1	1	1	1	1	2	2	2	1	1	1
	1-5	1	2	2	1	1	1	1	1	1	2	2	1	1	1	1	1	2
2		3	2	1	2	3	2	1	1	3	-	-	-	-	-	-	-	-
3	**3-1**	2	4	5	4	5	3	1	5	3	3	3	3	3	3	3	3	3
	3-2	3	5	4	5	3	4	5	3	2	4	2	2	2	2	2	2	2
	3-3	5	3	4	3	5	4	5	4	1	2	4	3	3	3	3	3	3
4	**4-1**	4	4	5	5	5	4	1	5	3	2	4	3	3	3	3	3	3
	4-2	3	5	4	3	5	4	1	3	2	3	2	2	2	2	3	3	2
	4-3	5	3	4	4	1	4	1	4	1	4	1	3	3	2	2	2	2
5	**5-1**	4	4	3	3	5	3	5	5	3	3	3	2	2	3	3	3	3
	5-2	2	5	4	4	2	3	5	3	2	3	3	3	3	2	2	3	3
	5-3	5	4	5	5	5	4	5	4	1	1	2	2	3	3	2	2	2
6	**6-1**	5	3	5	5	1	3	1	5	2	3	4	3	3	3	3	3	3
	6-2	3	4	4	4	5	3	1	1	1	2	2	2	3	2	2	2	3
7	**7-1**	5	5	5	4	2	4	3	5	3	3	3	3	2	3	3	2	2
	7-2	3	4	5	5	5	3	1	1	2	4	2	3	3	2	2	3	3
8	**8-1**	4	2	2	3	4	2	2	2	3	2	2	2	2	2	2	2	2
	8-2	2	2	2	2	2	2	2	1	3	2	2	2	2	2	2	2	2
9		4	4	4	4	4	3	3	4	4	4	4	4	4	4	4	4	4
10	**10-1**	3	2	2	4	3	1	3	2	2	2	-	2	1	2	2	2	2
	10-2	2	2	2	2	3	1	3	1	2	2	-	3	1	2	2	2	2
	10-3	2	2	1	2	2	1	3	1	2	2	-	2	1	1	1	1	1
	10-4	2	1	1	2	2	1	3	1	2	2	-	3	1	2	1	1	1
11		4	1	4	4	1	1	3	4	4	4	4	4	4	4	4	4	4
12		4	3	4	4	3	3	3	4	4	4	4	4	4	4	4	4	4
13	**13-1**	4	4	5	5	3	4	5	4	3	4	3	3	3	3	3	3	3
	13-2	4	5	5	4	5	5	5	5	2	2	2	3	2	2	2	2	3
	13-3	3	4	5	3	5	4	5	3	1	3	3	2	3	3	3	2	2
14	**14-1**	3	4	5	3	3	4	5	4	4	3	3	3	3	3	3	3	3
	14-2	4	4	5	4	5	5	5	5	3	2	2	2	2	2	3	2	3
	14-3	4	4	5	5	5	4	5	3	2	4	3	2	3	2	3	2	2

Table S3-2. Responses to quantitative questionnaire of individual participant (brownfield redevelopers from Shenyang city).

City and stakeholder		Shenyang city																
		Brownfield redevelopers																
Questions		Selections																
1	1-1	1	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1	2
	1-2	1	1	1	2	2	2	2	2	2	1	1	2	2	1	2	2	1
	1-3	2	2	1	1	1	1	1	2	1	1	1	2	2	2	1	1	1
	1-4	2	2	1	2	1	1	1	1	1	2	2	1	1	1	2	2	1
	1-5	3	2	1	1	1	1	1	2	2	2	1	1	2	1	2	1	1
2		3	2	2	2	2	1	3	2	2	2	2	2	1	3	2	2	2
3	3-1	4	5	2	4	5	2	5	3	1	2	3	5	2	4	1	2	4
	3-2	5	4	5	5	3	4	5	1	5	5	5	3	4	5	5	1	4
	3-3	3	3	1	4	3	5	5	1	4	2	5	4	5	3	2	3	5
4	4-1	4	5	2	4	5	3	4	3	1	1	4	5	2	4	1	3	5
	4-2	5	4	5	5	3	4	4	5	5	5	5	3	4	5	5	1	3
	4-3	3	3	1	4	4	5	5	4	4	2	4	4	5	3	3	2	5
5	5-1	1	5	2	3	5	4	4	4	1	2	5	4	3	3	1	1	4
	5-2	1	3	5	5	4	3	4	4	5	3	5	3	4	5	4	2	4
	5-3	1	2	1	5	4	4	5	4	4	5	4	5	5	4	3	3	5
6	6-1	1	1	3	3	3	4	4	4	1	3	3	3	4	3	4	3	3
	6-2	1	1	1	3	3	5	5	4	1	2	2	1	5	3	5	2	4
7	7-1	3	5	5	3	4	5	4	4	5	4	4	4	4	5	5	5	3
	7-2	3	5	5	3	4	5	5	4	1	2	3	2	5	5	5	3	5
8	8-1	4	3	2	1	2	2	3	2	2	3	3	2	2	1	1	2	4
	8-2	4	2	2	1	3	2	1	3	2	3	4	2	2	3	1	2	3
9		4	1	-	2	1	4	4	2	3	4	2	4	3	3	3	3	3
10	10-1	3	2	2	1	2	2	1	2	2	3	4	1	2	2	1	2	3
	10-2	2	2	2	1	2	3	1	2	2	3	4	2	2	2	2	2	3
	10-3	3	2	2	2	2	3	1	2	2	3	4	1	2	2	2	2	3
	10-4	2	2	1	2	2	2	1	2	2	3	3	1	2	3	2	2	3
11		4	2	1	2	2	3	2	2	3	4	2	3	4	4	3	1	2
12		4	3	4	3	4	3	3	3	4	4	3	4	3	3	4	4	2
13	13-1	5	5	5	5	5	5	3	4	4	5	5	5	4	5	5	2	4
	13-2	3	5	5	3	4	5	5	4	5	3	4	5	5	5	5	3	4
	13-3	3	5	5	5	4	5	5	4	3	3	3	3	5	5	5	4	5
14	14-1	5	5	5	5	5	4	5	4	4	5	4	5	5	5	5	2	5
	14-2	5	5	5	5	4	5	5	3	5	5	5	4	5	5	5	3	5
	14-3	5	5	5	5	4	4	5	4	3	4	5	3	5	5	5	4	5

Table S3-3. Responses to quantitative questionnaire of individual participant (members from third party from Shenyang city).

City and stakeholder		Shenyang city																			
		Members from third party																			
Questions		Selections																			
1	1-1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1
	1-2	1	2	2	1	2	2	1	2	1	2	1	2	1	1	3	1	1	2	1	1
	1-3	2	1	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1
	1-4	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1
	1-5	1	2	1	1	1	1	2	1	2	2	1	1	1	1	1	1	1	2	1	2
2		3	3	2	3	2	2	3	2	1	2	2	2	1	2	2	3	3		2	1
3	3-1	4	4	4	3	4	4	2	5	3	3	4	4	3	4	4	5	3	4	5	5
	3-2	3	5	5	5	4	5	5	3	5	5	5	5	4	5	3	4	3	5	5	5
	3-3	5	4	5	4	4	5	3	3	4	4	4	4	5	5	5	5	3	4	5	5
4	4-1	4	3	4	3	5	5	4	5	5	4	3	5	3	3	5	5	3	4	5	5
	4-2	3	5	5	5	3	5	3	5	4	5	4	4	4	4	3	4	3	5	4	4
	4-3	5	4	5	4	5	4	3	5	5	4	3	4	5	5	4	5	3	4	5	5
5	5-1	2	3	3	3	5	5	3	5	4	3	3	2	3	3	3	5	3	4	5	5
	5-2	4	3	3	5	5	5	3	5	4	3	5	4	4	5	4	4	3	5	4	3
	5-3	5	3	3	4	5	5	3	5	5	5	5	2	5	5	3	5	3	4	5	3
6	6-1	3	4	4	3	3	3	2	2	4	2	3	3	4	2	3	3	2	3	3	3
	6-2	2	2	4	3	2	2	2	2	4	2	4	2	4	4	4	3	2	2	3	2
7	7-1	4	4	5	5	5	5	3	5	5	4	4	5	3	4	4	4	2	4	5	4
	7-2	3	4	5	5	4	4	3	5	4	5	5	5	3	5	5	4	2	4	4	4
8	8-1	2	2	2	1	1	1	2	2	2	2	2	2	2	2	4	2	1	1	2	2
	8-2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	3	2	1	1	2	2
9		4	1	4	4	2	1	4	3	3	4	2	4	1	4	4	4	4		2	4
10	10-1	2	2	1	1	1	2	3	2	2	2	2	2	2	2	3	2	1	2	2	2
	10-2	3	1	2	1	2	2	3	2	2	2	3	2	1	2	3	2	1	2	2	2
	10-3	3	2	1	1	2	1	2	2	2	1	2	2	2	2	3	1	1	2	1	1
	10-4	2	2	2	1	2	1	2	2	2	2	1	2	1	1	3	1	1	2	1	1
11		4	4	3	4	2	4	4	3	3	4	2	2	1	3	2	1	4		2	4
12		4	3	3	4	4	3	3	3	3	3	3	4	4	4	4	3	4		3	4
13	13-1	5	5	5	3	5	4	3	3	5	5	5	5	5	5	3	3	2	2	3	3
	13-2	4	4	5	4	4	4	3	3	5	4	5	3	5	5	4	3	2	4	3	3
	13-3	3	4	5	2	4	4	3	3	4	4	5	3	5	5	5	3	3	3	3	3
14	14-1	5	4	5	5	5	5	3	3	5	4	5	4	5	5	3	4	4	4	5	4
	14-2	4	5	5	5	5	5	3	3	5	5	4	4	5	5	4	4	3	4	5	4
	14-3	3	4	5	5	5	5	3	3	4	5	5	3	5	5	5	4	3	4	4	3

Table S3-4. Responses to quantitative questionnaire of individual participant (city planners from Guangzhou city).

City and stakeholder		Guangzhou city																								
		City planners																								
Questions		Selections																								
1	1-1	1	1	1	1	2	1	1	1	1	1	2	2	1	2	1	1	1	1	1	1	1	1	1	1	1
	1-2	2	2	2	2	2	2	2	1	1	1	1	2	2	1	1	1	2	1	1	1	1	2	2	2	2
	1-3	2	2	2	2	2	2	2	2	2	1	1	1	2	1	2	1	1	1	1	1	1	2	2	2	2
	1-4	1	1	3	1	1	1	1	1	1	1	1	1	1	1	3	1	2	2	1	2	1	1	1	3	1
	1-5	1	2	2	3	2	2	2	2	2	2	1	1	1	1	2	1	1	2	1	2	1	1	2	2	3
2		3	2	1	2	3	1	2	2	1	1	1	1	2	3	2	3	3	2	2	2	1	3	2	1	2
3	3-1	4	5	5	4	5	3	4	5	5	5	5	4	4	4	3	5	2	4	4	5	4	4	5	5	4
	3-2	5	4	5	3	2	4	5	4	4	5	5	5	5	5	4	4	5	5	5	4	5	5	4	5	3
	3-3	5	4	2	5	4	5	5	4	4	5	5	3	5	5	5	5	1	4	5	3	5	5	4	2	5
4	4-1	4	5	5	4	5	3	3	5	5	5	5	4	3	5	5	5	3	3	4	3	5	4	5	5	4
	4-2	5	4	5	3	3	4	5	4	4	5	4	5	5	5	5	4	5	5	5	5	5	5	4	5	3
	4-3	5	4	2	5	4	5	4	4	4	5	5	3	4	4	5	5	2	4	5	4	5	5	4	2	5
5	5-1	4	5	5	4	5	3	5	5	5	5	4	5	3	5	2	5	1	4	4	2	5	4	5	5	4
	5-2	5	4	5	3	3	4	5	4	4	5	5	5	3	5	4	4	5	5	5	4	5	5	4	5	3
	5-3	5	4	4	5	4	5	5	4	4	5	5	3	5	5	5	5	3	4	5	5	5	5	4	4	5
6	6-1	-	-	-	-	1	2	-	-	3	2	4	2	3	3	4	-	2	4	4	2	2	-	-	-	-
	6-2	-	-	-	-	1	2	-	-	3	2	5	3	2	3	4	-	1	3	3	3	1	-	-	-	-
7	7-1	5	4	5	4	4	4	5	4	4	4	5		4	5	3	5	2	5	5	4	4	5	4	5	4
	7-2	5	4	5	4	4	3	5	4	4	4	5		4	5	4	4	1	5	5	4	4	5	4	5	4
8	8-1	2	3	3	2	2	2	3	2	2	2	2	2	2	2	2	2	3	3	3	2	2	2	3	3	2
	8-2	1	3	2	2	1	1	2	2	2	1	2	1	2	2	1	2	2	2	1	1	2	1	3	2	2
9		4	3	3	3	3	1	2	2	2	3	2	3	4	3	2	4	4	1	2	2	2	4	3	3	3
10	10-1	2	3	2	2	1	1	2	2	3	1	2	2	2	2	2	2	3	3	3	1	2	2	3	2	2
	10-2	2	2	2	2	1	1	2	2	2	1	3	1	1	2	2	2	3	2	2	2	2	2	2	2	2
	10-3	2	3	2	2	1	1	1	2	2	1	2	1	1	2	2	1	2	2	2	2	2	2	3	2	2
	10-4	2	4	2	2	1	1	1	2	2	1	2	1	1	1	2	1	2	1	1	1	2	2	4	2	2
11		4	3	3	3	3	2	1	3	3	3	3	3	3	3	2	2	1	1	2	2	2	4	3	3	3
12		4	3	4	4	4	3	3	3	3	3	3	4	3	3	4	3	4	4	4	4	3	3	3	4	4
13	13-1	5	5	5	5	4	5	5	4	4	5	5	5	5	5	3	5	3	5	5	5	5	5	5	5	5
	13-2	5	4	3	3	2	3	4	3	4	5	5	5	4	4	3	5	5	4	4	4	5	5	4	3	3
	13-3	5	4	3	3	3	3	3	3	3	5	4	4	4	3	4	4	3	4	4	4	5	5	4	3	3
14	14-1	5	4	4	4	3	3	4	3	3	5	5	5	5	5	3	5	3	5	5	3	5	5	4	4	4
	14-2	5	4	5	4	4	4	4	3	3	5	5	5	5	5	4	5	5	5	5	5	5	5	4	5	4
	14-3	5	4	3	3	2	3	3	3	3	5	5	5	3	4	3	4	3	5	5	4	5	5	4	3	3

Table S3-5. Responses to quantitative questionnaire of individual participant (brownfield redevelopers from Guangzhou city).

City and stakeholder		Guangzhou city															
		Brownfield redevelopers															
Questions		Selections															
1	1-1	2	1	1	1	1	2	2	1	2	2	1	2	1	1	1	1
	1-2	1	2	2	2	2	2	2	2	2	2	1	1	2	2	2	2
	1-3	1	1	1	1	2	1	1	1	1	2	1	1	1	1	1	2
	1-4	1	1	1	2	1	1	1	1	1	2	1	1	1	1	2	1
	1-5	1	1	2	1	1	1	1	3	2	2	1	1	1	2	1	1
2		3	3	3	3	2	2	3	3	2	1	3	2	3	3	3	2
3	3-1	5	4	4	4	4	4	3	3	5	3	5	5	4	4	4	4
	3-2	4	5	4	5	5	4	4	4	3	2	5	4	5	4	5	5
	3-3	5	4	5	4	4	5	5	5	4	3	4	5	4	5	4	4
4	4-1	4	4	5	3	5	4	3	4	5	3	4	4	4	5	3	5
	4-2	4	5	4	5	4	5	4	3	3	2	5	4	5	4	5	4
	4-3	5	3	5	3	5	5	5	4	4	3	4	5	3	5	3	5
5	5-1	3	3	4	3	5	4	3	3	5	1	4	3	3	4	3	5
	5-2	3	4	5	5	4	5	4	5	2	1	5	3	4	5	5	4
	5-3	5	2	5	3	5	5	5	4	3	1	5	5	2	5	3	5
6	6-1	2	4	2	2	3	3	5	4	5	2	2	2	4	2	2	3
	6-2	2	4	1	2	4	1	3	3	3	2	2	2	4	1	2	4
7	7-1	5	4	5	4	4	3	5	5	5	4	3	5	4	5	4	4
	7-2	5	4	4	4	4	1	4	4	4	4	3	5	4	4	4	4
8	8-1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2
	8-2	2	2	2	2	2	3	2	1	1	2	2	2	2	2	2	2
9		4	4	4	4	2	3	3	4	4	4	2	3	4	4	4	2
10	10-1	2	1	2	2	2	1	2	1	2	2	2	2	1	2	2	2
	10-2	2	1	2	2	2	1	1	2	1	2	2	2	1	2	2	2
	10-3	2	1	2	1	2	2	1	2	1	2	2	2	1	2	1	2
	10-4	1	1	2	1	2	1	1	1	1	2	2	1	1	2	1	2
11		4	1	3	4	2	4	4	4	2	2	2	1	1	3	4	2
12		4	3	4	3	3	4	3	4	4	4	4	4	3	4	3	3
13	13-1	5	5	5	5	3	4	4	4	5	5	4	5	5	5	5	3
	13-2	5	4	5	4	3	3	5	5	5	5	3	5	4	5	4	3
	13-3	5	3	4	4	3	1	3	5	4	5	3	5	3	4	4	3
14	14-1	5	4	5	4	4	4	5	5	5	5	5	5	4	5	4	4
	14-2	5	4	5	5	4	3	5	5	5	5	5	5	4	5	5	4
	14-3	5	3	5	5	3	2	4	5	4	5	5	5	3	5	5	3

Table S3-6. Responses to quantitative questionnaire of individual participant (members from third party from Guangzhou city).

City and stakeholder		Guangzhou city																													
		Members from third party																													
Questions		Selections																													
1	1-1	1	1	1	1	2	2	2	2	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	2
	1-2	3	1	1	1	2	2	2	2	2	1	2	1	1	2	1	2	1	1	1	1	2	1	2	3	1	1	1	2	2
	1-3	2	2	1	2	1	1	2	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	2	1	2	1	1
	1-4	1	2	1	1	1	1	1	1	1	3	1	1	1	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
	1-5	1	3	1	2	1	1	1	1	2	3	1	1	1	2	1	1	1	1	2	2	2	1	2	1	3	1	2	1	1
2		3	2	1	2	2	2	2	2	2	3	2	2	2	3	1	3	2	1	1	3	2	3	1	2	2	1	2	2	2
3	3-1	3	5	4	4	4	3	4	4	1	4	2	5	4	4	5	4	5	4	3	4	2	5	5	3	5	4	4	4	3
	3-2	5	4	5	5	5	5	4	5	3	5	5	4	4	5	4	5	5	3	4	5	3	4	4	5	4	5	5	5	5
	3-3	4	4	5	5	4	4	4	4	4	1	4	3	5	4	4	4	5	3	5	3	3	3	4	4	4	5	5	4	4
4	4-1	3	5	4	5	5	1	4	4	1	4	2	5	4	4	5	5	5	4	4	4	3	5	5	3	5	4	5	5	1
	4-2	5	4	5	4	4	5	4	4	3	5	5	4	4	5	5	5	4	4	4	5	3	5	4	5	4	5	4	4	5
	4-3	5	3	5	4	4	3	4	4	5	3	3	3	5	4	5	4	5	3	5	3	3	4	4	5	3	5	4	4	3
5	5-1	3	3	3	5	3	1	4	5	1	3	2	5	4	3	5	5	5	4	2	4	3	4	4	3	3	3	5	3	1
	5-2	5	4	5	4	5	5	4	3	3	5	5	4	5	4	5	5	3	4	5	5	2	4	4	5	4	5	4	5	5
	5-3	5	5	5	5	3	4	4	5	2	2	4	3	5	4	5	4	3	3	5	3	3	5	5	5	5	5	5	3	4
6	6-1	2	5	4	5	2	3	4	3	1	1	2	4	4	3	5	1	1	1	2	1	1	2	2	2	5	4	5	2	3
	6-2	3	3	5	3	1	3	1	3	3	1	3	3	3	3	4	2	2	1	2	1	1	4	3	3	3	5	3	1	3
7	7-1	4	5	4	5	5	5	5	5	1	3	5	5	4	4	5	4	5	3	5	4	3	4	3	4	5	4	5	5	5
	7-2	3	4	5	4	4	5	4	5	5	3	5	4	5	5	5	4	5	3	4	4	3	4	2	3	4	5	4	4	5
8	8-1	1	2	1	2	2	2	2	2	2	3	2	2	2	3	2	2	1	2	3	2	1	1	1	1	2	1	2	2	2
	8-2	2	2	2	2	2	2	2	2	2	1	1	2	3	3	2	4	4	2	2	2	2	4	2	2	2	2	2	2	2
9		4	4	2	4	3	4	4	2	2	4	1	4	2	2	4	4	4	4	4	3	3	3	3	2	4	2	4	3	4
10	10-1	1	3	2	1	2	2	3	2	1	3	2	3	2	3	2	3	2	2	3	2	2	3	2	1	3	2	1	2	2
	10-2	2	2	3	1	1	2	2	2	1	3	1	2	3	3	2	3	3	2	2	2	2	2	1	2	2	3	1	1	2
	10-3	1	1	2	2	1	1	1	1	1	2	1	2	3	3	2	3	3	3	2	2	2	3	1	1	1	2	2	1	1
	10-4	2	1	4	1	1	1	1	1	1	1	1	2	2	3	2	3	2	3	1	2	2	2	1	2	1	4	1	1	1
11		4	2	2	4	2	4	1	2	3	1	1	1	2	2	3	3	3	1	1	4	3	3	2	2	2	2	4	2	4
12		4	4	3	3	3	4	4	3	3	4	3	4	3	3	4	3	3	3	3	3	3	3	3	3	4	3	3	3	4
13	13-1	5	5	5	5	5	5	4	5	4	3	5	4	5	4	4	5	5	5	5	4	3	4	5	5	5	5	5	5	5
	13-2	4	5	5	3	5	5	5	5	5	5	5	3	5	3	5	5	4	3	4	5	3	5	3	4	5	5	3	5	5
	13-3	3	4	5	4	4	5	3	5	3	3	5	3	5	3	4	4	3	3	4	4	3	5	3	3	4	5	4	4	5
14	14-1	3	4	5	3	5	5	4	5	5	3	5	4	5	5	4	5	5	4	5	5	3	4	3	3	4	5	3	5	5
	14-2	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5	3	4	4	3	5	5	5	5	5	5	5	5
	14-3	3	4	5	4	4	5	3	5	3	3	5	3	5	4	4	4	4	3	4	4	3	5	4	3	4	5	4	4	5

Table S3-7. Responses to quantitative questionnaire of individual participant (city planners from Wuhan city).

City and stakeholder		Wuhan city																														
		City planners																														
Questions		Selections																														
1	1-1	2	1	2	1	1	1	2	2	1	2	1	2	2	1	1	1	1	1	1	1	2	1	1	1	1	2	1	2	1
	1-2	2	2	2	2	1	3	2	2	1	2	1	2	2	2	2	1	2	1	1	1	2	3	1	1	1	2	2	2	2
	1-3	2	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	3	1	1	1	2	1	1	1
	1-4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1
	1-5	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1
2		3	2	2	2	2	2	2	2	1	3	3	2	1	1	2	3	3	3	2	1	2	2	1	2	2	2	2	2	2
3	3-1	3	4	1	4	3	2	5	5	3	2	4	5	5	2	2	3	3	1	5	1	3	5	2	5	5	3	4	1	4
	3-2	3	5	5	4	5	4	4	3	2	3	5	4	3	1	3	5	4	2	4	5	4	3	5	5	4	3	5	5	4
	3-3	5	4	3	5	4	5	3	4	5	5	5	4	5	2	4	5	4	1	4	1	4	3	3	3	3	5	4	3	5
4	4-1	3	4	3	4	4	2	3	5	3	2	4	5	5	2	3	5	3	1	5	1	4	5	4	5	5	3	4	3	4
	4-2	5	5	4	5	5	5	5	3	2	3	5	5	3	1	4	5	4	2	5	5	3	2	4	5	2	5	5	4	5
	4-3	3	4	3	5	4	5	5	4	5	5	5	4	5	2	3	5	4	1	5	1	3	3	3	3	3	3	4	3	5
5	5-1	3	1	2	3	4	2	2	5	1	3	4	4	2	2	2	5	4	2	5	1	4	2	2	4	3	3	1	2	3
	5-2	3	3	5	4	4	3	5	3	2	2	5	4	3	1	3	4	4	3	5	5	5	2	4	4	1	3	3	5	4
	5-3	5	4	5	5	5	5	4	4	5	2	5	4	5	1	3	4	4	3	5	1	5	3	5	4	3	5	4	5	5
6	6-1	1	2	2	4	2	3	4	2	4	2	5	4	5	5	2	4	3	3	1	2	2	1	1	3	3	1	2	2	4
	6-2	1	3	4	3	3	3	4	3	4	3	4	3	4	5	3	4	3	3	1	1	2	2	1	3	1	1	3	4	3
7	7-1	1	4	5	3	2	5	5	5	5	4	5	5	5	1	3	5	3	3	3	5	5	2	5	5	4	1	4	5	3
	7-2	1	4	4	4	2	1	5	4	5	4	5	5	5	1	4	4	3	3	3	5	5	2	5	5	3	1	4	4	4
8	8-1	2	3	2	2	2	2	2	2	1	2	3	2	3	3	3	3	1	2	4	3	2	2	4	1	2	2	3	2	2
	8-2	1	1	2	2	2	2	2	1	1	1	2	2	1	2	2	3	1	2	4	3	2	2	2	1	2	1	1	2	2
9		4	3	3	4	4	2	3	3	4	4	2	2	4	3	2	4	3	2	3	4	4	3	1	4	4	2	3	3	4
10	10-1	2	2	1	2	3	3	2	2	2	2	2	2	2	2	2	3	1	2	4	2	2	2	3	1	3	2	2	1	2
	10-2	1	2	1	2	2	1	2	1	1	2	2	2	2	2	2	3	1	1	4	2	2	2	2	1	1	1	2	1	2
	10-3	1	2	1	2	1	1	2	1	1	1	2	1	1	2	2	3	1	2	4	1	2	1	3	1	2	1	2	1	2
	10-4	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	3	1	2	4	1	2	2	1	1	1	1	1	1	2
11		4	2	2	2	4	2	3	3	3	3	2	3	1	2	2	3	4	1	2	4	1	2	2	4	1	4	2	2	2
12		4	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	4	3	3	2	3	2	4	3	3	2
13	13-1	2	4	2	5	4	4	4	5	5	5	5	4	5	5	5	5	3	3	5	4	3	4	5	4	5	2	4	2	5
	13-2	5	4	5	5	5	5	4	5	5	5	5	5	4	5	3	5	3	5	5	5	5	4	5	5	4	5	4	5	5
	13-3	2	4	5	5	5	3	4	4	5	4	5	5	4	5	3	4	3	5	5	5	5	3	5	5	3	2	4	5	5
14	14-1	2	4	2	5	5	5	4	5	3	5	5	4	5	5	4	5	3	3	5	5	3	4	5	5	5	2	4	2	5
	14-2	5	4	4	5	5	5	4	5	5	5	5	5	5	5	4	4	3	5	5	5	5	4	5	5	5	5	4	4	5
	14-3	2	4	3	5	5	3	4	5	5	4	5	5	5	5	3	4	3	5	5	5	5	5	5	5	4	2	4	3	5

Table S3-8. Responses to quantitative questionnaire of individual participant (brownfield redevelopers from Wuhan city).

City and stakeholder		Wuhan city																											
		Brownfield redevelopers (Part 1)																											
Questions		Selections																											
1	1-1	1	2	1	2	2	2	1	1	2	1	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	2	
	1-2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	1	3	2	2	1	1	2	2	2	2	2	
	1-3	1	1	1	2	2	1	1	1	1	1	1	2	2	2	1	2	2	1	2	2	1	1	2	1	1	1	2	
	1-4	1	2	2	1	1	1	1	2	3	2	2	1	2	1	1	2	1	3	2	1	1	1	2	1	2	2	1	
	1-5	2	1	1	1	1	1	1	1	1	1	2	1	2	1	2	1	1	1	1	1	1	1	2	2	1	1	1	
2		3	1	1	2	3	2	1	3	2	3	2	2	3	2	3	3	2	3	3	3	3	3	2	1	1	1	2	
3	3-1	5	5	4	5	3	4	4	4	4	5	4	3	3	4	5	3	2	1	2	2	3	1	1	5	5	4	5	
	3-2	4	3	5	4	5	3	5	5	4	5	3	2	4	5	4	1	1	1	3	3	2	1	1	4	3	5	4	
	3-3	4	3	3	5	4	5	5	4	5	4	5	3	3	4	3	1	1	1	2	1	1	1	1	4	3	3	5	
4	4-1	5	5	4	5	3	4	4	4	4	5	5	4	3	3	5	2	2	1	1	3	1	1	2	5	5	4	5	
	4-2	4	4	5	4	5	3	5	5	4	5	4	3	4	5	4	1	1	1	3	1	1	1	2	4	4	5	4	
	4-3	5	4	3	5	4	5	5	4	5	4	3	3	3	4	3	1	1	1	3	1	1	1	2	5	4	3	5	
5	5-1	5	4	4	4	2	5	4	5	5	4	3	4	3	2	2	4	2	1	3	2	1	1	1	5	4	4	4	
	5-2	4	3	5	4	5	5	3	5	4	4	5	3	4	5	3	1	3	2	3	1	1	1	1	4	3	5	4	
	5-3	4	3	3	5	3	3	5	5	4	5	4	3	3	3	3	1	2	1	4	2	1	1	1	4	3	3	5	
6	6-1	3	4	2	5	3	1	5	5	5	2	3	3	4	3	1	2	2	1	4	3	1	5	2	3	4	2	5	
	6-2	3	3	2	4	3	3	5	4	5	2	4	3	3	3	1	1	1	1	2	1	1	5	2	3	3	2	4	
7	7-1	3	3	1	5	3	4	4	5	5	4	4	4	4	3	3	1	3	1	4	3	5	5	1	3	3	1	5	
	7-2	3	3	1	4	3	3	4	4	3	3	5	2	3	3	3	1	1	2	3	2	5	5	1	3	3	1	4	
8	8-1	3	1	2	2	2	1	2	3	2	3	2	2	1	2	1	2	2	2	1	2	1	1	1	3	1	2	2	
	8-2	3	2	2	2	3	1	2	4	2	3	2	2	2	2	4	1	2	1	2	1	1	1	2	3	2	2	2	
9		4	3	3	3	2	2	1	4	4	3	2	4	3	4	3	4	4	3	3	3	3	3	4	3	3	3	3	
10	10-1	3	2	2	2	2	2	2	4	2	3	2	2	2	2	3	2	2	2	1	2	1	1	1	3	2	2	2	
	10-2	3	2	3	1	2	2	2	4	2	3	2	2	2	2	4	1	2	2	4	1	1	1	1	3	2	3	1	
	10-3	3	2	3	1	2	2	2	4	2	3	2	2	1	2	2	1	2	2	2	2	1	1	1	3	2	3	1	
	10-4	3	2	3	1	2	1	2	4	2	3	2	2	1	2	2	1	2	2	2	1	1	1	1	3	2	3	1	
11		4	1	3	3	2	3	1	3	4	2	2	1	3	1	3	4	3	3	4	3	3	3	4	1	1	3	3	
12		4	2	3	3	4	3	3	2	3	2	3	4	3	4	4	3	2	3	3	3	3	3	3	4	2	3	3	
13	13-1	4	5	5	5	3	4	5	5	5	5	3	4	4	5	1	4	1	1	4	1	5	5	5	4	5	5	5	
	13-2	5	5	3	4	3	5	5	5	5	5	3	5	4	4	1	1	2	2	4	2	5	5	5	5	5	3	4	
	13-3	4	4	3	4	3	5	5	5	4	4	3	4	4	3	1	1	2	3	4	3	5	5	5	4	4	3	4	
14	14-1	4	5	4	5	3	4	5	5	5	5	3	4	4	5	1	1	1	1	4	2	5	5	5	4	5	4	5	
	14-2	5	5	4	4	4	5	5	5	5	5	3	5	4	4	1	5	1	1	4	2	5	5	5	5	5	4	4	
	14-3	4	5	3	4	4	5	5	5	4	5	3	4	4	3	1	1	4	1	4	3	5	5	5	4	5	3	4	

Table S3-9. Responses to quantitative questionnaire of individual participant (brownfield redevelopers from Wuhan city).

City and stakeholder		Wuhan city																										
		Brownfield redevelopers (Part 2)																										
Questions		Selections																										
1	1-1	2	1	2	1	1	1	2	1	1	1	2	1	2	1	1	2	2	2	1	1	1	1	2	1	2	1	
	1-2	2	2	1	1	2	2	2	1	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	2	1	1	
	1-3	1	1	1	1	1	2	2	2	1	1	1	1	2	1	2	1	1	1	1	1	1	2	1	1	1	1	
	1-4	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	
	1-5	1	2	1	1	1	2	2	2	1	1	1	2	1	1	2	2	2	2	1	1	2	1	1	2	1	1	
2		3	3	3	3	2	2	2	2	1	1	3	2	1	3	2	2	2	2	3	3	3	3	2	3	3	3	
3	3-1	5	4	5	3	2	1	5	5	5	4	3	4	4	3	3	4	4	3	4	4	1	2	5	4	5	3	
	3-2	3	4	2	3	5	5	5	3	1	4	5	4	3	5	5	5	5	4	4	4	1	5	3	4	2	3	
	3-3	5	5	5	3	5	1	3	2	1	5	4	4	5	3	3	4	4	5	5	5	1	5	5	5	5	3	
4	4-1	5	3	5	2	2	5	5	4	5	4	4	4	4	4	3	5	4	3	4	3	2	5	5	3	5	2	
	4-2	3	4	2	2	3	5	5	5	1	3	5	4	5	5	5	4	5	5	3	4	1	3	3	4	2	2	
	4-3	5	5	5	3	4	1	3	2	1	5	4	4	5	3	4	4	4	5	5	3	1	3	5	5	5	3	
5	5-1	3	3	4	3	2	1	3	4	5	4	2	4	4	4	3	4	4	3	3	4	3	3	3	3	4	3	
	5-2	3	4	3	3	4	1	3	4	5	5	4	4	4	5	5	5	5	5	3	4	4	5	3	4	3	3	
	5-3	5	5	5	3	3	1	5	4	5	3	3	4	5	3	5	4	4	3	5	5	5	3	5	5	5	3	
6	6-1	3	3	1	3	3	1	3	1	5	3	3	4	2	3	2	4	5	4	5	5	4	4	3	3	1	3	
	6-2	3	2	1	3	3	1	3	4	1	3	3	4	2	3	1	4	4	3	5	5	5	4	3	2	1	3	
7	7-1	5	5	5	3	2	1	4	4	5	5	4	5	4	5	4	5	5	3	5	5	2	4	5	5	5	3	
	7-2	5	2	4	3	3	1	4	4	1	5	4	5	4	4	4	4	4	3	5	5	5	4	5	2	4	3	
8	8-1	1	2	1	2	2	1	1	1	2	1	2	3	2	1	2	3	3	2	2	2	3	3	1	2	1	2	
	8-2	2	2	1	2	2	1	2	2	3	2	2	3	2	2	2	3	3	3	3	3	3	4	2	2	1	2	
9		4	4	4	4	4	3	2	4	4	1	2	2	2	2	4	2	3	3	3	1	1	4	1	4	4	4	
10	10-1	1	2	1	1	2	1	2	2	1	1	2	3	3	1	2	2	2	2	3	2	2	2	1	2	1	1	
	10-2	1	2	1	1	2	1	1	1	1	2	2	3	3	1	2	2	2	3	3	2	1	3	1	2	1	1	
	10-3	1	2	1	1	2	1	2	1	2	2	2	3	3	1	2	2	2	2	3	2	1	3	1	2	1	1	
	10-4	1	2	1	1	2	1	2	2	2	2	1	3	2	1	1	2	2	2	3	2	1	3	1	2	1	1	
11		4	1	3	1	4	3	1	2	3	1	1	2	3	2	4	4	4	4	3	1	1	1	1	1	3	1	
12		4	2	2	3	3	2	3	1	3	3	3	3	3	3	3	3	3	3	3	4	3	4	1	2	2	3	
13	13-1	3	5	4	5	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	3	5	4	5	
	13-2	5	5	5	5	3	5	5	4	5	5	4	5	4	4	4	5	5	4	4	5	4	4	5	5	5	5	
	13-3	5	4	4	5	2	1	5	4	5	3	4	5	4	4	4	4	5	3	4	5	5	5	5	4	4	5	
14	14-1	3	5	4	5	2	5	5	5	4	4	5	5	4	5	5	5	5	5	5	5	4	4	3	5	4	5	
	14-2	5	5	5	5	3	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	
	14-3	5	4	4	5	2	1	5	4	4	4	5	5	4	5	5	4	4	3	5	5	5	5	5	4	4	5	

Table S3-10. Responses to quantitative questionnaire of individual participant (members from third party from Wuhan city).

City and stakeholder		Wuhan city																	
		Members from third party																	
Questions		Selections																	
1	1-1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2
	1-2	2	3	3	1	1	1	1	2	2	1	1	1	2	2	2	2	2	2
	1-3	1	1	2	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1
	1-4	1	2	1	1	1	1	1	2	1	1	1	1	3	2	1	2	1	1
	1-5	2	1	1	1	1	1	1	1	1	1	1	1	3	3	1	1	2	1
2		3	3	2	3	2	2	3	3	3	2	1	3	3	2	2	3	3	3
3	3-1	5	3	4	2	3	5	4	3	2	5	5	5	4	3	3	3	3	5
	3-2	5	5	3	5	5	4	4	4	4	4	5	5	5	5	4	4	4	4
	3-3	5	4	5	5	4	4	5	5	3	4	5	5	1	3	5	5	5	5
4	4-1	5	1	4	4	3	5	4	3	3	5	5	5	3	1	2	4	5	5
	4-2	4	5	2	5	4	3	4	4	5	4	5	4	1	5	5	5	1	4
	4-3	4	5	5	5	5	5	5	5	4	4	5	5	1	5	4	5	3	5
5	5-1	5	1	3	5	4	3	4	3	2	5	5	5	4	1	3	3	4	5
	5-2	4	5	3	3	4	3	5	4	3	4	4	4	1	5	4	3	2	4
	5-3	4	5	5	3	5	4	5	5	4	4	5	4	1	3	5	5	4	5
6	6-1	5	5	4	3	2	2	5	4	3	4	5	2	3	1	4	2	4	5
	6-2	4	3	1	4	3	2	3	5	2	3	4	2	1	3	5	2	2	3
7	7-1	5	5	5	3	4	4	5	2	5	4	5	4	3	1	5	4	2	5
	7-2	3	3	4	4	5	3	5	3	4	4	5	4	3	5	5	5	4	5
8	8-1	2	4	3	3	2	4	4	1	2	3	2	2	2	1	2	2	2	2
	8-2	2	2	2	2	2	3	2	2	3	3	3	3	3	2	3	1	3	3
9		4	3	4	2	2	2	4	3	1	3	3	3	4	3	2	2	3	4
10	10-1	2	2	3	2	4	3	2	1	4	3	2	3	2	2	3	2	2	2
	10-2	1	2	2	1	2	3	2	3	4	3	3	3	3	2	3	2	2	2
	10-3	1	2	2	2	2	2	2	2	4	2	3	3	3	2	3	2	2	2
	10-4	1	2	2	2	2	2	2	2	4	2	2	2	3	2	3	2	2	2
11		4	2	4	3	1	2	3	4	1	2	3	3	4	1	3	2	3	3
12		4	2	3	3	1	4	3	3	3	3	3	3	3	3	3	3	3	2
13	13-1	4	5	3	3	5	5	5	5	5	5	5	5	3	5	5	5	2	5
	13-2	4	4	4	5	5	4	5	4	5	4	5	4	2	3	3	5	1	5
	13-3	4	3	4	5	5	3	5	4	4	4	5	4	2	5	3	5	4	5
14	14-1	4	5	3	3	5	5	5	5	3	4	4	5	3	5	3	5	3	5
	14-2	4	4	4	5	5	5	5	4	5	5	5	5	3	3	5	3	1	5
	14-3	4	3	4	5	4	3	5	4	5	5	5	5	3	5	5	4	4	5