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An applied planning support toolkit including quantitative methods, software and models in China

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Abstract: Planning support systems (PSSs) have attracted extensive attention from scholars and decision makers for decades. Most of the existing research on PSSs is related to system design, implementation, application as well as evaluation of a standalone system in one area, e.g. *What if?*, CommunityViz and INDEX. There is no existing research on an entire framework of PSSs for various types of plans. In this paper, we propose a PSS framework for various types of plans in China, e.g. master plan, detailed plan, municipal infrastructure plan and transport plan. Based on an extensive literature review and multiple rounds of planner and decision maker surveys, the framework focuses on two aspects. On one hand, we itemize plan contents (termed as “plan elements”) into various steps for each type of plan, e.g. population forecasting and establishing urban growth boundaries in a master plan. On the other hand, we list related PSSs for each plan element. In our research, PSSs embody three forms, which are existing PSS software (e.g. *What if?* and INDEX), planning support models to be developed or already developed as well as quantitative methods (e.g. scenario analysis, systems analysis, and logistic regression). The two dimensional framework provides a full picture of PSS applications in various types of plans. The framework has been applied in the Beijing Institute of City Planning (BICP) for several months, and has attracted hundreds of application requests from planners.

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1 Introduction

For decades China has witnessed rapid urban growth, especially of its large cities. Urban planning plays an important role in leading a sustainable development pattern. Planning support systems (PSSs) to support urban plan compilation and evaluation have attracted extensive attention from scholars and decision makers. Most of the existing research on PSSs is related to system design, implementation and application as well as evaluation of a standalone system in one area, e.g. *What if?*, CommunityViz and INDEX. The uptake of the developed PSSs is not advanced

(Vonk, 2005; Vonk, 2007). In addition, most of the planners in China have backgrounds in architecture and lack quantitative analysis skills, let alone using a PSS. For this, the paper describes the construction, set-up and first evaluation-by-users of a large framework with an overview of plan 'elements' (stages in preparing plan documents such as Town Master Plans) and possible supporting methods, software and models (Planning Support components). The framework serves as a PSS Toolkit for the Beijing Institute of City Planning (BICP). A first user evaluation confirms that an online version of the “overview framework” serves its purpose as knowledge base within the institute BICP. We hope this work as an expert system for PSS selection for various types of plans in China, based on a conceptual framework of the planning process, can promote the application of PSSs in practical urban planning.

The concept of a “planning support system” (PSS), initially proposed by Harris (1960), was considered to be the latest form of computer-aided planning system (Geertman and Stillwell 2004; Klosterman 1997). Several books on PSSs have been published in recent years (Brail and Klosterman 2001; Geertman and Stillwell 2003; Brail 2008; Geertman and Stillwell 2009). PSSs have been applied mainly in spatial plans (Geneletti 2008; Kammeier 1999), urban environment improvement plans (Edamura and Tsuchida 1999), industrial location choices (Kammeier 1999), and land use plans (Klosterman 1999). Single PSS implementations and applications are reviewed widely in the literature. Typical PSSs related to land use plan are listed in Table 1. Various approaches have been used in these PSSs, and numerous factors are input into PSSs to predict land use patterns based on different scenarios. However, most of these PSSs focus on a single aspect of urban planning, and, to the best of our knowledge, there is no existing reported research proposing a framework for various kinds of plans. The most relevant research is Geertman and Stillwell (2004), which reviewed a basket of PSSs.

Table 1. An inventory of typical PSSs

Publication	PSS name	Approach (es)
Landis 1994; Landis and Zhang 1998a, 1998b	CUF/CUF-2	Rule-based land suitability analysis
Clark et al. 1997	SLEUTH	Cellular automata
Wu 1998	SimLand	Cellular automata, AHP
Shi and Yeh 1999	N/A	Case-based reasoning
Klosterman 1999	What if?	Rule-based land suitability analysis
Allen 2001	INDEX	Rule-based land suitability analysis
Waddell 2002	UrbanSim	Microsimulation, discrete choice models
Lautso 2002	SPARTACUS (based on MEPLAN)	Input-output model, discrete choice models
Yeh and Qiao 2004	KBPSS	Knowledge-based reasoning

Publication	PSS name	Approach (es)
Carmichael et al. 2004	GB-QUEST	Rule-based land suitability analysis
Placeways, LLC	CommunityViz	Rule-based land suitability analysis
Li and Liu 2008	N/A	Cellular automata, multi-agent
Long et al. 2009	BUDEM	Cellular automata, logistic regression

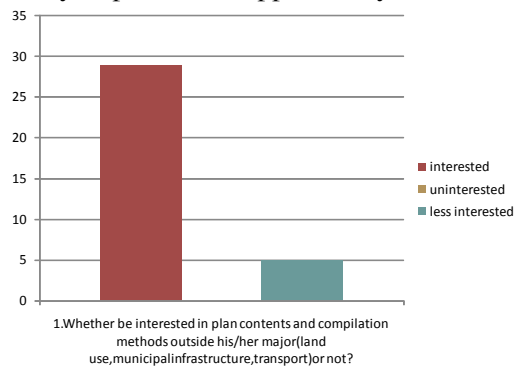
Research relating to PSSs in China has been carried out frequently since the concept of PSS was first introduced into China in 2003 by Liu (2003). Du and Li (2005) applied *What if?* to a Chinese urban master plan. There have been two books published on PSSs, Yeh et al. (2006) and Long (2007), the second of which focused on geospatial techniques for establishing PSSs. Li (2010) analyzed the current condition of and future prospects for PSSs. Li and Zhan (2011) developed a PSS named UPlan. Long et al. (2011) developed an urban containment PSS in Beijing. The development and application of a standalone PSS is still the emphasis for Chinese researchers. Now, researchers in China are beginning to focus on proposing general techniques or multi-cases related to PSSs. For instance, Niu (2012) published a PSS book in which he proposed over 40 GIS tools as PSSs, including six basic aspects: fundamental techniques, spatial overlay, 3D analysis, transportation network, spatial research and planning information management. A project conducted by the Chinese Academy of Urban Planning proposed a framework of digital techniques for urban planning and developed dozens of tools for urban master plans and detailed plans (Luo et al. 2009). In addition, decision support systems (DSS) or management information systems (MIS) are extensively applied in the Chinese urban management bureau or commission in the process of data management and issuing of land permits. In contrast to the information techniques used in the field of urban management, PSS is not much used by agencies and institutes compiling urban plans. In conclusion, there is a large body of literature in China in this field and some researchers have begun to combine various techniques to propose a framework of PSSs although most of them are still under development.

This paper is organized as follows. Section 2 introduces various methods we have applied in establishing the PSS framework. Section 3 illustrates the framework we have developed as well as an online query system for an improved application of this framework. We discuss the application of the framework in BICP and its potential contributions in Section 4. Last, we draw several conclusions and propose future research into the PSS framework.

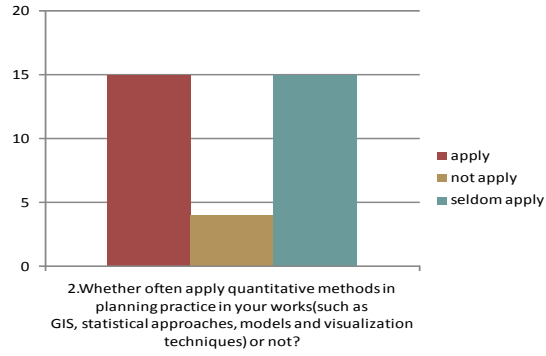
2 Methods for establishing the framework

2.1 Requirement analysis

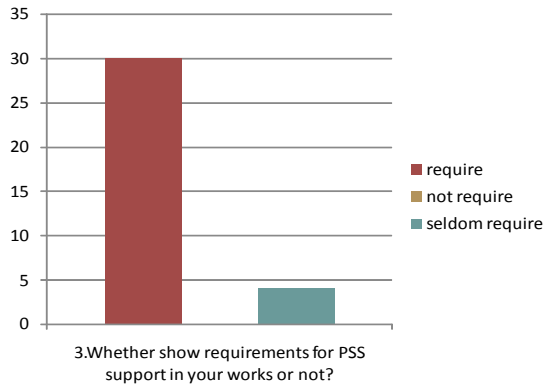
We used two methods to conduct the requirement analysis for the framework: two rounds of seminars and a survey. We held two seminars for planners to discuss the requirements of the framework. One seminar was held at the very beginning of the research, and the other was held when we were seeking feedback on a preliminary framework. In the first seminar, the 10 planners involved made 20 suggestions. Most of suggestions focused on the applicability of the framework as well as more types of plans to be included. Some also argued that the framework should be prepared for the next stage PSS development. In the second seminar, the 20 planners involved gave us 30 comments and suggestions. Most of them suggested that, based on their experience, several more detailed models, including those developed by BICP, should be included in the framework. Planning evaluation is also a very important aspect to include. The dataset required by each PSS is also necessary. In addition, at the very beginning of the research, we designed an online survey with six questions relating to the requirements for the proposed framework. We conducted this in BICP and got 34 responses (from a total of about 300 planners in BICP). Figure 1 shows the questions and the statistical results. From 34 responses, 29 planners were interested in plan contents and compilation methods from outside of their major area of interest. Nineteen planners had never or seldom applied quantitative methods in their planning practice, methods such as GIS, statistical approaches, models and visualization techniques. Thirty planners saw opportunities for PSSs to support their work, and 30, 7 and 27, respectively, saw opportunities for existing condition analysis, plan scheme compilation and plan evaluation in their work. Overall, planners in BICP showed great interest in using PSSs in their work, although this is not yet common. Their involvement in seminars and the survey significantly improved the applicability of the framework.



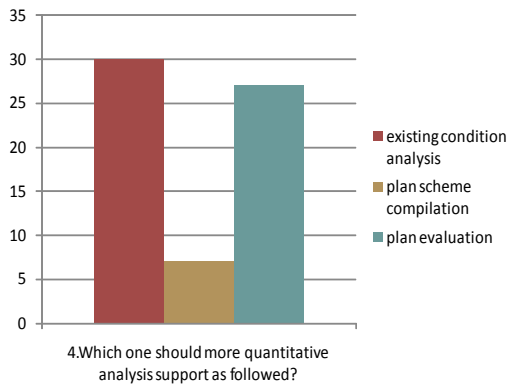
(a)



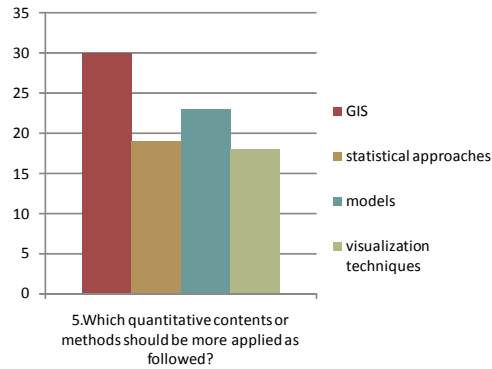
(b)



(c)



(d)



(e)

Fig. 1. The survey results regarding the requirements for the framework

2.2 Selecting the form of the framework

We designed the overall PSS framework based on the requirement analysis. First, we focused on both the urban plan compilation and evaluation. Second, we included both existing PSSs and PSSs under development by BICP in the framework. Third, quantitative methods/theories, although not PSSs, were included in the framework to broaden the horizons of BICP planners, who, we understand, mostly have backgrounds in architecture and lack quantitative analysis skills. Fourth, existing conditions as a key procedure of plan compilation and evaluation were highlighted in the framework. Fifth, the framework was as detailed as possible for planners' queries and applications. According to these principles, the structure of the PSS framework is in two dimensions (see Figure 2), the vertical dimension is for each plan element, which is a part of a type of plan. The horizontal dimension is each PSS technique including both theories and tools. Details of the framework format are as follows.

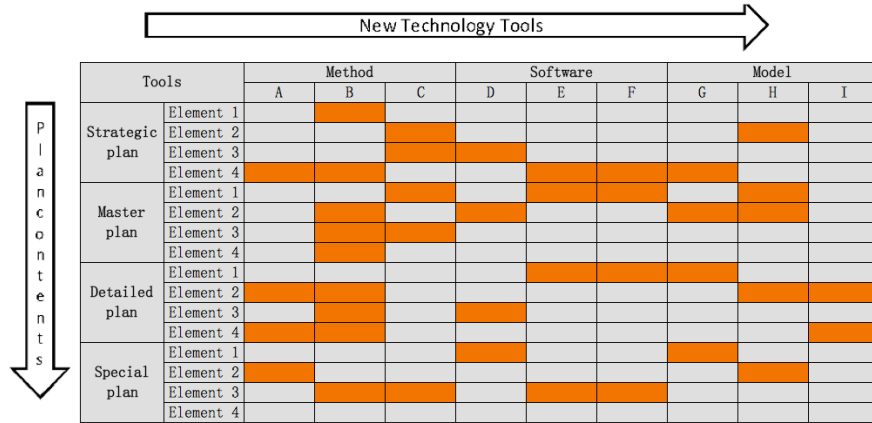


Fig. 2. The simplified PSS framework (Cells in dark means a PSS tool, a method, software of model, could be adopted to support the plan element)

2.3 The selection of plan elements

We based the selection of plan elements involved in the framework on existing urban planning laws, regulations and standards in China. The key reference was the City Planning Law of the People’s Republic of China enacted in 2008, which defines the urban-rural planning system for plan compilation and plan evaluation. Plan compilation was further divided into downtown plans, new city plans, town plans and rural plans, and each type was further divided into master plan and detailed plan levels. Therefore, plans involved in the framework included both plan compilation and evaluation, as shown in Table 2. In this stage, we focused more on plan compilation than evaluation in the framework in line with dominating historical and existing planning role of BICP, although Figure 1 shows that more planners are interested in applying PSSs in plan evaluation. We will extend the framework for plan evaluation in a near future.

Table 2. Plan types involved in the framework

Level 1	Level 2	Level 3-1	Level 3-2	Level 3-3
Part1: Plan Compilation				
1 Strategic Plan	1.1 Spatial Development Research			
2 Master Plan	2.1 Downtown Master Plan	2.2 New City Master Plan	2.3 Town Master Plan	
3 Detailed Plan	3.1 Street Level	3.2 Lot Level	3.3 City Design	
4 Municipal Topic	4.1 Water Supply Plan	4.2 Storm Water Drainage Plan	
5 Transport Topic	5.1 Transport Demand Plan	5.2 Road Network Plan	
6 Special Plan	6.1 Elementary Education Facilities Special Plan	6.2 City Fire Equipment Special Plan	

Level 1	Level 2	Level 3-1	Level 3-2	Level 3-3
Part 2: Plan Evaluation				
1 Master Plan Evaluation 1.1 Urban Master Plan Evaluation				

Each plan in Level 3 was further itemized into various plan elements, for which we proposed a PSS in the framework. The plan elements were confirmed based on existing planning laws and guidelines, as well as recommendations from BICP. For example, 1.1 Spatial development was divided into several plan elements, including landscape analysis, existing condition analysis, land use suitability analysis as well as population distribution analysis. All these elements should be addressed under spatial development within a strategic plan (See Appendix 1 and the online attachment of the paper for all the plan elements).

2.4 The selection of PSS types

We classified PSSs into three forms, quantitative methods, software and models, based on an extensive literature review into PSS definitions as well as information from face-to-face expert surveys.

1. Quantitative methods were documented in the textbooks of various urban planning-related disciplines, for example urban economics, urban geography, system science and geographical information science. These methods, like scenario analysis, systems dynamics and genetic algorithms, were extensively applied in urban studies and planning practice. Urban planners are generally required to master these methods.
2. Software in this paper was defined as existing PSSs developed by developers outside BICP, like ArcGIS, *What if?* and INDEX, commercial, shared, or free, which could support plan compilation and evaluation. It should be noted that some models like UrbanSim were also listed as software since they were not developed by BICP.
3. A model in our framework was defined as a tool specially developed to implement a function to support plan compilation or evaluation. Generally, models were all developed or will be developed by BICP, while existing models developed by third parties were excluded. Models in the framework were highlighted and will be regarded as the base for the next steps in various phases of PSS development.

2.5 Proposing PSSs for plan elements

Proposing appropriate PSSs for each plan element was the core procedure in establishing the PSS framework. Researchers with backgrounds ranging from urban planning, transport planning, municipal infrastructure planning to social planning were involved in this process. Literature review was the dominant approach used for proposing PSSs for each plan element. We also held several extra seminars for BICP planners to evaluate the proposed framework. More than ten urban planning experts were involved in developing this framework.

3 The new framework

3.1 The framework and detailed descriptions

We developed a comprehensive PSS framework for various kinds of urban plans in China. Using the methods for designing the framework, we proposed 128 methods, 59 software programs, and 58 models to be included in it. Table 3 shows a part of the framework. The complete framework, including inventories of methods, software and models, is in Appendix 1. For an example of the plan element “urban growth boundaries” in spatial layout of master plan compilation, the full description for the element is “delimit the urban expansion and settle the boundary of built-up area”. Various datasets including boundary and area of built-up area over the years, previous land use plans, DEM, socioeconomic status, municipal infrastructure, transport infrastructure, land use status, as well as constraining elements are necessary for establishing urban growth boundaries. Methods like cellular automata and trend analysis, and software like SWARM, REPAST, NETLOGO and ArcGIS (Spatial Analysis module) could be used in the process. Furthermore, we propose several existing or to-be-developed models, e.g. Beijing Urban Spatial Development Model (BUDEM), Urban Growth Control Model (UGCM) and Land Use Layout Analysis Model (LULAM), to support establishing urban growth boundaries.

Table 3. Part of the PSS framework proposed

Level 4	Planning element	Descriptions	Data	Method	Software	Model
Problem analysis	Topography and geomorphology	Analyze the topography and geomorphology, construct the digital elevation model, and compute the slope and aspect	DEM, RS		ArcGIS (3D Analyst Tools)	Basic topography model
	Current conditions	Analyze the current situations of natural resources, historical evolution, spatial layout, infrastructure and social and economic issues	Natural resources (ecological environment, land resource, water resources, etc.), engineering geological conditions, historical and cultural resources, land cover status, municipal infrastructure, transport infrastructure, population, industry		PSS tools of Chenghui, ArcGIS (Analysis Tools), Excel	Status comprehens model
	Land use suitability	According to the requirements of land cover, analyze the land cover suitability (usually divided into suitable, comparatively suitable and unsuitable levels), determine the constraining factors of exploitation, find out the optimal way of land use and a sound plan scheme	Elevation, slope, existing land cover, existing land cover, municipal infrastructure, transport infrastructure, natural resources (water source, wet land, forest)	Grid algebra operation, multi-attribute evaluation, basic topography analysis model, grey system theory	ArcGIS (Spatial Analyst Tools)	Land use suitability model
	Population spatial distribution	According to the population of each statistical unit, display and analyze the spatial distribution of population with a continuous surface of population density using spatial interpolation	Population and land use in towns and sub districts (total number of population and buildings)	Density core analysis, spatial interpolation, monte carlo	ArcGIS (Spatial Analyst Tools), GeoDA	Spatial distribut population predic
Forecast of development trend and scale	Population development trend	Analyze the scale of population in different historical stages and judge the development trend in the future	Demographic data over the years	Synthetic growth-rate method	SPSS, Excel	
	Urbanization development trend	Analyze the spatial distribution, expansion, direction and mechanism of urban construction land in different historical stages (e.g. location, accessibility and public policy)	Existing land cover, existing land use, DEM, municipal infrastructure, transport infrastructure over the years	Remote sensing interpretation, Logistic Regression model, principal component analysis, phase analysis, land use evolution analysis model	Erdas, Envi, ArcGIS (Spatial Analyst Tools), SPSS (Logistic regression, correlation analysis, principal component analysis), GWR3A	Land use evolution model, Beijing CI development analysis

We have detailed descriptions for each PSS in the framework, which readers can use to learn more about the PSS. In addition, several models have been developed in BICP, like BUDEM, BLUTI, SWMM and SCD.

3.2 The online query system

In addition to a hard-copy version of the framework, we have created an online version of the framework, from which one could query related PSSs for a plan element, query the application fields of a specified PSS, and learn about a PSS with downloadable materials in PDF form. The main interface of the online query system is shown in Figure 3. This browser-based system was developed using Asp.Net and C# on a Windows 2003 platform. The contents of the framework were stored in a Microsoft SQL Server 2005. The functions of the system included: (1) querying required PSSs/data/guidelines for a specified plan element; (2) querying the plan elements where a specified PSS could be applied; (3) downloading existing PSSs; (4) querying the person in charge of a PSS; (5) searching a plan element of PSS. This system was installed on the BICP intranet and could be easily accessed by planners in the institute via a browser.

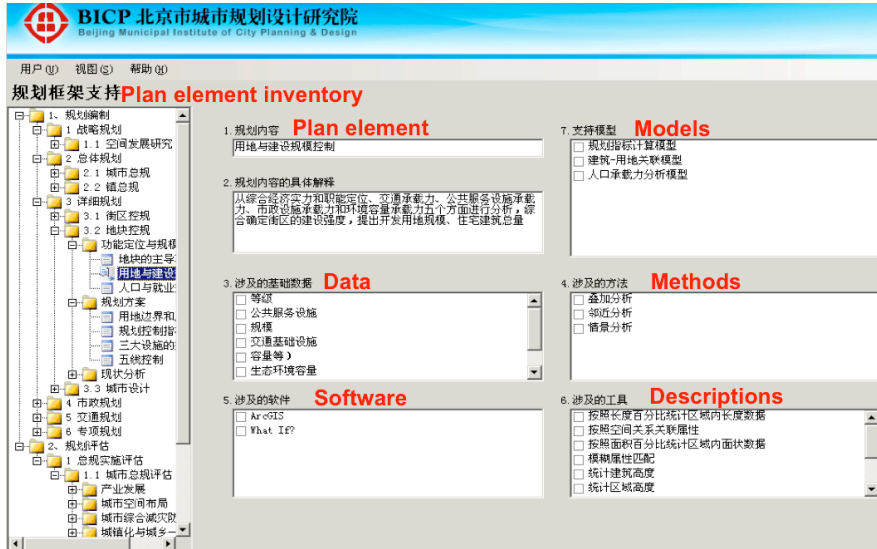


Fig. 3. The main graphical user interface of the online query system for the PSSs framework

4 Discussion

4.1 Application and user evaluation of the framework in BICP

The framework has been available at BICP, a top official planning agency in China with more than 300 planners, for several months. It has attracted hundreds of application requests from planners. The applications of the framework include the following aspects.

First, we developers organized a large-scale training workshop for all planners in BICP so as to widely apply the framework in BICP. The contents of the workshop range from the development background, overall structure, user manual of the online system, as well as our further plans. Most of planners agreed that they have gained basic knowledge on the framework and its user manual.

Second, BICP planners regard the framework as a knowledge base of PSSs. In the framework, each PSS has been associated with a planner who is familiar with and experienced in its use. The users can contact the associated person to gain more knowledge in the usual way by Instant Messenger in BICP. Building on BICP's existing spatial databases, the framework can promote the application of new techniques in urban planning compila-

tion and evaluation. Currently these techniques are not common in architecture-dominated official and private planning institutes in China, thus our framework has potential applications in those entities. The application of the framework could broaden the horizons of planners by introducing a large body of planning support techniques and then promoting their efficiency and increasingly scientific results.

Third, BICP planners regard this framework as a knowledge base of urban planning theories. New urban planners could complete practical tasks more effectively using information from the framework. Newcomers could get to know the detailed procedure of a specific job, like a detailed plan in a town, by checking the plan element rows of the framework. In addition, planners with various backgrounds like urban planning, transport planning and municipal infrastructure planning could learn more about unfamiliar plan fields. In current China, it is not easy for planners to familiarize themselves with different specialist areas. Assisted by the framework, this situation is expected to improve and new plan schemes are expected to be better than before because of more shared understanding among planners of various backgrounds. As a byproduct, planners in different fields could get familiar with plan contents of others by querying the framework, a process that was not easy prior to the launch of the framework.

Fourth, we drafted the development plan of PSSs in BICP using the new framework. We have decided to develop several fundamental urban models during 2011–2015, based on aggregating models in the framework. These models include the existing land analysis model, the urban spatial development model, the land use and transportation integrated model, the low carbon urban model, the urban planning implementation evaluation model, and the municipal facility evaluation model, as well as the storm water management model.

4.2 Potential contributions

The contributions of our research in the regime of PSS are as follows. First, to our knowledge, this research is the first attempt to establish a comprehensive PSS framework including quantitative methods, models and software for various types of plans, rather than a standalone PSS. The framework is an integration of existing PSSs and those yet to be developed. Second, this framework is a form of urban planning knowledge base, in which users with different education background can share their knowledge both on urban planning theory and PSSs. It will be a complementary digital infrastructure for the well-studied spatial database and is expected to promote the potential application of PSSs. It could also be used as training material for novices in this field. Third, the development plan for the PSSs can be compiled based on the new framework, which provides a platform for both long-term goals and short-term development. Seven comprehensive models, e.g. urban spatial development model and

existing condition evaluation model, have been proposed to develop by BICP during 2011-2015. Fourth, this research has passed the rigid review process by PSS processors and practitioners in China. The review reports said the work as a fundamental research has its potential extended application and could promote PSS development in the whole country.

5 Conclusions and next steps

In this paper, we have proposed a PSS framework for various types of plans in China, e.g. master plan, detail plan, municipal infrastructure plan and transport plan. Based on an extensive literature review and several rounds of planner and decision maker surveys, the framework focuses on two aspects. On one hand, we itemized plan contents (termed as “plan elements”) into various steps for each type of plan, e.g. population forecasting and establishing urban growth boundaries (UGBs) in master plans. On the other hand, we listed related PSSs for each plan element. In our research, PSSs embody three forms, existing PSS software (e.g. *What if?* and INDEX), planning support models to be developed in the future or already developed, as well as quantitative methods (e.g. scenario analysis, systems analysis, and logistic regression). The two dimensional framework provides a full picture of PSS application in various types of plans. This framework has two forms of application, the hard copy and the online system. We have revised the established framework several times following discussions with and feedback from planners using the framework. This framework is a first systematic attempt to integrate existing planning support techniques and provides users/planners with a knowledge base in both planning procedures and PSS. It is being heavily used in BICP.

Finally, there are several actions that can enhance this study. First, more plan types are expected to be included in the framework, e.g. more special plans and planning evaluation, as highlighted in the latest City Planning Law of the People’s Republic of China. Second, PSS items like existing methods and software can be continuously enriched by literature reviews and planner surveys. Third, the online query system can be further developed by linking existing data and PSSs to run the PSS directly in the online system. Fourth, BICP will develop new planning support models and specify them in the proposed framework.

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Appendix 1: The framework

BICP-PSS

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
Plan compilation	Strategic plan	Spatial development research	Problem analysis	Topography and geomorphology	Analyze the topography and geomorphology, construct the digital elevation model, and compute the slope and aspect	DEM, RS		ArcGIS (3D Analyst Tools)	Basic topography analysis model
				Current conditions	Analyze the current situations of natural resources, historical evolution, spatial layout, infrastructure and social and economic issues	Natural resources(ecological environment, land resource, water resources, etc.), engineering geological conditions, historical and cultural resources, land cover status, municipal infrastructure, transport infrastructure, population, industry		PSS tools of Chenghui, ArcGIS (Analysis Tools), Excel	Status comprehensive analysis model
				Land use suitability	According to the requirements of land cover, analyze the land cover suitability (usually divided into suitable, comparatively suitable and unsuitable levels), determine the constraining factors of exploitation, find out the optimal way of land use and a sound plan scheme	Elevation, slope, existing land cover, existing land cover, municipal infrastructure, transport infrastructure, natural resources(water source, wet land, forest)	Grid algebra operation, multi-attribute evaluation, basic topography analysis model, grey system theory	ArcGIS (Spatial Analyst Tools)	Land use suitability analysis model
				Population spatial distribution	According to the population of each statistical unit, display and analyze the spatial distribution of population with a continuous surface of population density using spatial interpolation	Population and land use in towns and sub districts(total number of population and buildings)	Density core analysis, spatial interpolation, monte carlo	ArcGIS (Spatial Analyst Tools), GeoDA	Spatial distribution of population prediction model
			Forecast of development trend and scale	Population development trend	Analyze the scale of population in different historical stages and judge the development trend in the future	Demographic data over the years	Synthetic growth-rate method	SPSS, Excel	
				Urbanization development trend	Analyze the spatial distribution, expansion, direction and mechanism of urban construction land in different historical stages(e.g. location, accessibility and public policy)	Existing land cover, existing land use, DEM, municipal infrastructure, transport infrastructure over the years	Remote sensing interpretation, Logistic Regression model, principal component analysis, phase analysis, land use evolution analysis model	Erdas, Envi, ArcGIS (Spatial Analyst Tools), SPSS (Logistic regression, correlation analysis, principal component analysis), GWR3X	Land use evolution analysis model, beijing city spatial development analysis model
				Constraints of spatial development	Analyze the favorable factors and constraints of development in the context of the location	Administrative boundary, DEM, socioeconomic situation, regional transport system, key infrastructure in Beijing, Tianjin, Hebei, the country and the world	Multi-attribute evaluation	ArcGIS (Spatial Analyst Tools)	Location analysis model
				Population and land use scale forecast	Forecast the scale of the urban and rural population and land use scale based on the rational requirements of urban development	Population data over the years(permanent resident population, temporary resident population; population with Hukou, floating population; urban population, rural population) and its detailed constitution(age, gender, education, career); land use status over the years; previous land use plans	Synthetic growth-rate method, correlation analysis, resource&environment capacity analysis, exponential growth model, logistic population model, leslie population model, lewis dualistic economy Model, lewis dualistic economy Model, todaro Migration Model, population redistribution theory	SPSS (Time Series), Excel	Predicting gross population model
				Population bearing capacity analysis	Determine the population that can be fed by the limited resources	Total amount of land resource, water resource, farm land and green space	Single factor analysis method, resource comprehensive balanced method, scenario analysis		Population bearing capacity analysis model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Spatial development strategy	Urban-rural integration	According to the requirements, propose suggestions on integration with adjacent administrative regions of the spatial layout, construction of key infrastructure and public service facilities, environmental conservation and urban-rural development	Administrative boundary, socioeconomic situation, regional transport system, key infrastructure in Beijing, Tianjin, Hebei, the country and the world		ArcGIS (Spatial Analyst Tools) , Excel	Status comprehensive analysis model
				Spatial regulation	Determine the comprehensive goals and requirements of conservation and utilization of environment, land and water resources, energy, natural and historical heritages, etc.	Natural resources, energy, historical and cultural heritages		ArcGIS (Analysis Tools)	Status comprehensive analysis model
				Urban system plan	Forecast the total population and level of urbanization of the municipal region and determine the population, function, spatial layout and construction standard of each city and town	Current urban system, natural geographic condition, socioeconomic situation, land cover status, key infrastructure, public service facilities, DEM	Scenario analysis , multi-attribute evaluation, the lowry model		Population bearing capacity analysis model, location analysis model
				Key city and town plan	Propose the development orientation, land use scale and construction land control of key cities and towns	Current urban system, natural geographic condition, socioeconomic situation, land cover status, key infrastructure, public service facilities, DEM	Principal component analysis, markov process, Thunen location, weber location, palander location, Losch principle, Voronoi Polygon, alonso ground rent theory, filter theory, exchange theory, agent-based modeling	SWARM, REPAST, NETLOGO, UC-PSS, ArcGIS (Spatial Analyst Tools) , AgentAnalyst	Beijing city spatial development analysis model, location analysis model
				Significant infrastructure layout	Determine the development strategy of regional transportation; determine the layout of key infrastructure, social and economic service facilities and facilities for production and storage of hazardous goods, such as transportation, communication, energy, water supply, drainage, flood protection and refuse disposal etc.	Current key infrastructure, planned population scale	Utility theory	ArcGIS (Spatial Analyst Tools)	Beijing city spatial development analysis model, public service facilities Comprehensive model
				Urban planning area delimitation	Delimit the urban planning area according to the requirements of urban construction, development and resource management	Planned population scale, current urban system, land cover status, key infrastructure, DEM			Beijing city spatial development analysis model
	Master plan	City master plan	Current situation analysis	Location analysis	Analyze the favorable factors and constraints of development in the context of the location	Administrative boundary, DEM, socioeconomic situation, regional transport system, key infrastructure in Beijing, Tianjin, Hebei, the country and the world	Multi-attribute evaluation	ArcGIS (Spatial Analyst Tools)	Location analysis model
				Topography and geomorphology	Analyze the topography and geomorphology, construct the digital elevation model, and compute the slope and aspect	DEM, RS		ArcGIS (3D Analyst Tools)	Basic topography analysis model
				Current conditions	Analyze the current situations of natural resources, historical evolution, spatial layout, infrastructure and social and economic issues	Natural resources(ecological environment, land resource, water resources, etc.), engineering geological conditions, historical and cultural resources, land cover status, municipal infrastructure, transport infrastructure, population, industry		PSS tools of Chenghui, ArcGIS (Analysis Tools) , Excel	Status comprehensive analysis model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
				Land use suitability	According to the requirements of land cover, analyze the land cover suitability (usually divided into suitable, comparatively suitable and unsuitable levels), determine the constraining factors of exploitation, find out the optimal way of land use and a sound plan scheme	Elevation, slope, existing land cover, existing land cover, municipal infrastructure, transport infrastructure, natural resources(water source, wet land, forest)	Grid algebra operation, multi-attribute evaluation, basic topography analysis model, grey system theory	ArcGIS (Spatial Analyst Tools)	Land use suitability analysis model
				Urban construction land expansion	Analyze the spatial distribution, expansion, direction and mechanism of urban construction land in different historical stages(e.g. location, accessibility and public policy)	Existing land cover, existing land cover, DEM, municipal infrastructure, transport infrastructure over the years	Remote sensing interpretation , Logistic Regression model , principal component analysis, phase analysis, land use evolution analysis model	Erdas, Envi, ArcGIS (Spatial Analyst Tools) , SPSS (Logistic regression, correlation analysis, principal component analysis) , GWR3X	Land use evolution analysis model, beijing city spatial development analysis model
				Public service infrastructure	Assess the current situation of the public service such as education, medical care and sports from the aspect of scale, type and layout etc.	Level, scale and spatial layout of public service facilities(commercial, educational, health, sports, entertainment, cultural, scientific research, endowment, funeral, etc.)		ArcGIS (Analysis Tools)	Status comprehensive analysis model, public service facilities Comprehensive model
				Population spatial distribution	According to the population of each statistical unit, display and analyze the spatial distribution of population with a continuous surface of population density using spatial interpolation	Population and land use in towns and sub districts(total number of population and buildings)	Density core analysis, spatial interpolation, monte carlo	ArcGIS (Spatial Analyst Tools) , GeoDA	Spatial distribution of population prediction model
				Residence construction and housing security	Assess the current situation of commercial and indemnificatory housing from the aspect of scale, type and layout etc.	Population, land use status, building size and real estate exploitation data(size, layout, price etc.)		ArcGIS (Analysis Tools) , Excel	Real estate price model, residential location choice model, real estate site choice model
			Social and economic development	Population and land use scale forecast	Forecast the scale of the urban and rural population and land use scale based on the rational requirements of urban development	Population data over the years(permanent resident population, temporary resident population; population with Hukou, floating population; urban population, rural population) and its detailed constitution(age, gender, education, career); land use status over the years; previous land use plans	Synthetic growth-rate method , correlation analysis, resource&environment capacity analysis, exponential growth model, logistic population model, leslie population model, Lewis dualistic economy	SPSS (Time Series) , Excel	Predicting gross population model
				Employment forecast	Forecast the total and the composition of employment based on the requirements of urban economic development	Scale and industry constitution of employment over the years	Scenario analysis , system dynamics	Excel	Employment prediction model
				Population bearing capacity analysis	Determine the population that can be fed by the limited resources	Total amount of land resource, water resource, farm land and green space	Single factor analysis method, resource comprehensive balanced method, scenario analysis		Population bearing capacity analysis model
			Spatial layout	Urban spatial expansion direction	Determine the main direction of future urban space exploitation by comprehensively considering the organic connection between regions and the constraints of natural conditions	Socioeconomic situation, regional transport system, key infrastructure, development plan of surrounding cities, land use status and constraining elements(elevation, slope, wetland, green space, geology, earthquake, environment conservation, historical relics etc.) in Beijing, Tianjin and Hebei	Multi-attribute evaluation, fractal analysis	ArcGIS (Spatial Analyst Tools)	Location analysis model, land use suitability analysis model
				Urban spatial structure	Determine the urban spatial structure, i.e. the spatial distribution and combination of urban elements, which usually demonstrates as density, layout and morphology; assess the urban spatial layout such as the barycenter, compactness, dispersion, mixedness etc.	DEM, socioeconomic status, municipal infrastructure, transport infrastructure, land use status, constraining elements, land use plan	Doubly-constrained gravity model, the lowry model, central place theory, multi-attribute evaluation, scenario analysis , alonso ground rent theory	ArcGIS (Spatial Analyst Tools) , Fragstats	Beijing city spatial development analysis model, urban spatial morphology structure assessment model
				Urban growth boundary	Delimit the urban expansion and settle the boundary of built-up area	Boundary and area of built-up area over the years, previous land use plans, DEM, socioeconomic status, municipal infrastructure, transport infrastructure, land use status, constraining elements	Cellular automata, trend analysis	PSS tools of Chenghui, SWARM, REPAST, NETLOGO, ArcGIS (Spatial Analyst Tools) , UrbanSim	Beijing city spatial development analysis model, limit area planning model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
				City territory land use plan	Delimit various land use in urban regions and determine the usage of land	Previous land use plans, planned population scale, planned land scale, industry development plan, function division, cadastre, land use status, public service facilities, municipal infrastructure, transport infrastructure	Cellular automata, multi-agent system, scenario analysis, multi-attribute evaluation	What If, CUF, ArcGIS (Spatial Analyst Tools)	Beijing city spatial development analysis model, limit area planning model, land use Function layout analysis model
				Central city land use plan	Delimit various land use in central city and determine the usage of land	Previous land use plans, planned population scale, planned land scale, industry development plan, function division, cadastre, land use status, public service facilities, municipal	Cellular automata, multi-agent system, scenario analysis, multi-attribute evaluation	What If, CUF, ArcGIS (Spatial Analyst Tools)	Beijing city spatial development analysis model, limit area planning model, land use Function layout analysis model, residential
				Low-carbon urban morphology analysis	Assess the energy consumption and carbon emission of life, production and transportation corresponding to the planned spatial layout	Land use plan, planned population scale, industry development plan, household OD survey, green space plan, municipal infrastructure plan, transport infrastructure plan		ArcGIS (Spatial Analyst Tools), REMOVE, ECHAM5, NCAR-CCSM3	Low-carbon city morphological analysis model
			Conservation plan of historic cities	Historical evolution	Analyze the changes in location, scale and morphology of the old city in different historical stages	Old city map of different historical stages	Space syntax	ArcGIS (Spatial Analyst Tools)	
				Spatial pattern of old city	Assess the spatial morphology of the old city area using the theory of landscape ecology	Hutong texture, historical relics(distribution, scale, level and conservation scope)		Fragstats, ArcGIS (Spatial Analyst Tools)	Status comprehensive analysis model, urban spatial morphology structure assessment model
				Preservation of urban landscape skyline and street opposite scenery	Pick out the urban landscape skylines, protect the street opposite scenery of the crossings and the bending streets, propose the requirements on height, size and morphology of buildings in the respect of urban design	Landscape sensitive spots, main streets, land use plan(regulatory level), height control zoning	Isovist analysis, space syntax, kyline analysis	ArcGIS (3D Analyst Tools), BICP 3D, AxWoman, SketchUp	Visibility analysis model
			Public service infrastructure plan	Public service infrastructure system plan	Determine the development goal, scale and layout of public service facilities according to the regulations and development requirements	Land use status, public service facility, planned population scale, land use plan	Linear programming, grey programming, dynamic programming, network analysis, scenario analysis	MATLAB, PSS tools of Chenghui	Public service facilities Comprehensive model, status comprehensive analysis model
				Public service infrastructure location selection	Determine the specific location of certain public service facility according to the regulations and development requirements under certain restraining conditions	Land use status, public service facility, planned population scale, land use plan	Multi-objective programming, genetic algorithm, artificial neural network, integer programming, 非线性 programming, simulated annealing algorithm, scenario analysis	MATLAB, PSS tools of Chenghui, ArcGIS (Network Analyst Tools, Spatial Analyst Tools)	Public service facilities location selection model, status comprehensive analysis model
				Distinctive areas identification	Identify areas with high density of this kind of facility as the distinctive areas according to the spatial distribution of it	Public service facility	Density core analysis, cluster analysis	ArcGIS (Spatial Analyst Tools), GeoDA	
			Industry plan	Industry layout plan	Make scientific plans of the development orientation, structure and spatial layout of the industry through a full consideration of the economic development trend	Regional industry development status, socioeconomic development, population, natural resources, land use plan	Retail gravitation rules, system dynamics	ArcGIS (Analysis Tools), Excel, PySal	Industry location selection model
			Disaster prevention facility plan	Emergency shelter, lifeline system, underground space					
			Environmental plan	Construction restricted zone plan	Delimit the construction-fit, construction-restricted and construction-prohibited zone for urban construction land	Constraining elements(public green space, protection green space, landscape and famous scenery, natural reserve, forest park, forest land, earthquake, flood storage and detention basin, etc.)	Grid algebra operation, multi-attribute evaluation	ArcGIS (Analysis Tools)	Limit area planning model
				Ecological sensitivity	Propose the level of sensitivity of the reaction of certain ecological process in ecosystem on human activities, generally divided into extreme sensitivity, high sensitivity, medium sensitivity, low sensitivity and insensitivity	Constraining elements, TM images	Grid algebra operation, multi-attribute evaluation, NDVI index computation	ArcGIS (Analysis Tools), Erdas	Ecological sensitive assessment model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
				Landscape ecological security pattern	Evaluate the landscape ecological security pattern composed by patch, corridor and matrix	Land for ecological use(public green land, protection green space, natural reserve, forest park, forest land, etc.)	Landscape pattern valuation, oxygen source greenland calculation method, NDVI index computation	Fragstats, ArcGIS (Analysis Tools)	Landscape index comprehensive evaluation model
				Environmental pollution control plan	Measures of environmental pollution control, mainly consisting of water, air, sound and solid pollution	Current pollution sources, environment monitoring data, environment pollution prevention facility, socioeconomic development plan		ArcGIS (Analysis Tools)	
		Town master plan	Location analysis	Location analysis	Analyze the favorable factors and constraints of development in the context of the location	Administrative boundary, DEM, socioeconomic situation, regional transport system, key infrastructure in Beijing, Tianjin, Hebei, the country and the world	Multi-attribute evaluation	ArcGIS (Spatial Analyst Tools)	Location analysis model
			Current situation analysis	Topography and geomorphology	Analyze the topography and geomorphology, construct the digital elevation model, and compute the slope and aspect	DEM, RS		ArcGIS (3D Analyst Tools)	Basic topography analysis model
				Current conditions	Analyze the current situations of natural resources, historical evolution, spatial layout, infrastructure and social and economic issues	Natural resources(ecological environment, land resource, water resources, etc.), engineering geological conditions, historical and cultural resources, land cover status, municipal infrastructure, transport infrastructure, population, industry		PSS tools of Chenghui, ArcGIS (Analysis Tools) , Excel	Status comprehensive analysis model
				Land use suitability	According to the requirements of land cover, analyze the land cover suitability (usually divided into suitable, comparatively suitable and unsuitable levels), determine the constraining factors of exploitation, find out the optimal way of land use and a sound plan scheme	Elevation, slope, existing land cover, existing land cover, municipal infrastructure, transport infrastructure, natural resources(water source, wet land, forest)	Grid algebra operation, multi-attribute evaluation, basic topography analysis model, grey system theory	ArcGIS (Spatial Analyst Tools)	Land use suitability analysis model
				Public service infrastructure	Evaluate the scale, grade and spatial layout of public service facilities according to regulations and development requirements	Land use status, public service facility	Multi-attribute evaluation	ArcGIS (Spatial Analyst Tools)	Public service facilities Comprehensive model, status comprehensive analysis model
				Industry development	Analyze the current scale, structure and layout of primary industry, secondary industry and tertiary industry	Regional industry development status, socioeconomic development, population, natural resources	Input-output analysis	ArcGIS (Analysis Tools) , Excel	Status comprehensive analysis model, industry location selection model
			Social and economic development	Employment forecast	Forecast the total and the composition of employment based on the requirements of urban economic development	Scale and industry constitution of employment over the years	Scenario analysis , system dynamics	Excel	Employment prediction model
				Population bearing capacity analysis	Determine the population that can be fed by the limited resources	Total amount of land resource, water resource, farm land and green space	Single factor analysis method, resource comprehensive balanced method, scenario analysis		Population bearing capacity analysis model
			Development scale forecast	Population and land use scale forecast	Forecast the scale of the urban and rural population and land use scale based on the rational requirements of urban development	Population data over the years(permanent resident population, temporary resident population; population with Hukou, floating population; urban population, rural population) and its detailed constitution(age, gender, education, career); land use status over the years; previous land use plans	Synthetic growth-rate method , correlation analysis, resource&environment capacity analysis, exponential growth model, logistic population model, leslie population model, lewis dualistic economy Model,lewis dualistic economy Model, todaro Migration Model, population redistribution theory	SPSS (Time Series) , Excel	Predicting gross population model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Land use layout	Urban spatial expansion direction	Determine the main direction of future urban space exploitation by comprehensively considering the organic connection between regions and the constraints of natural conditions	Socioeconomic situation, regional transport system, key infrastructure, development plan of surrounding cities, land use status and constraining elements(elevation, gradient, wetland, green space, geology, earthquake, environment conservation, historical relics etc.) in Beijing, Tianjin and Hebei	Multi-attribute evaluation, fractal analysis	ArcGIS (Spatial Analyst Tools)	Location analysis model, land use suitability analysis model
				Urban spatial structure	Determine the urban spatial structure, i.e. the spatial distribution and combination of urban elements, which usually demonstrates as density, layout and morphology; assess the urban spatial layout such as the barycenter, compactness, dispersion, mixedness etc.	DEM, socioeconomic status, municipal infrastructure, transport infrastructure, land use status, constraining elements, land use plan	Doubly-constrained gravity model, the lowry model, central place theory, multi-attribute evaluation, scenario analysis, alonso ground rent theory	ArcGIS (Spatial Analyst Tools), Fragstats	Beijing city spatial development analysis model, urban spatial morphology structure assessment model
				Town territory land use plan	Delimit various land use in urban regions and determine the usage of land	Previous land use plans, planned population scale, planned land scale, industry development plan, function division, cadastre, land use status, public service facilities, municipal infrastructure, transport infrastructure	Cellular automata, multi-agent system, scenario analysis, multi-attribute evaluation	What If, CUF, ArcGIS (Spatial Analyst Tools)	Beijing city spatial development analysis model, limit area planning model, land use Function layout analysis model
			Greenland plan						
		New town master plan	See CITY MASTER PLAN						
	Detailed plan	Regulatory detailed plan of street layer	Block partitioning	Zone division	Divide the city or the region into several zones according to the layout characteristics, the road network and the	Administrative boundary of district and town, geographic code(street, address, place name, neighbourhood, railway, river)	Equidensity technique method, equilibrium distribution, scenario analysis	Control regulation integration system, ArcGIS	Planning unit subdivision model
				Block division/new town zone division	Divide the zones into blocks for planning, with a size of 2-3 km2 for each block, according to the boundaries like urban arterial	Administrative boundary of district and town, geographic code(street, address, place name, neighbourhood, railway, river)	Equidensity technique method, equilibrium distribution, scenario analysis	Control regulation integration system, ArcGIS	Planning unit subdivision model
			Current situation analysis	Location analysis	Determine the population that can be fed by the limited resources	Administrative boundary, DEM, socioeconomic, regional transport system, key infrastructure, land use status	Multi-attribute evaluation	ArcGIS (Spatial Analyst Tools)	Status comprehensive analysis model, location analysis model
				Natural resources	Determine the type and range of blocks in need of preservation and control through a comprehensive consideration of	Natural resources, topography and geomorphology, DEM, engineering geological conditions	Slope analysis, 3D analysis, overlay analysis, drainage basin partition model	ArcGIS (3D Analyst Tools)	Basic topography analysis model, drainage basin partition model
				Land use and construction conditions	Analyze the current situation of land use and building layout, delimit the land use for reconstruction and new construction	Land use status, RS data, topographic map(including building model)	Scenario analysis, overlay analysis	ArcGIS (Analysis Tools), Erdas, Envi	Land use suitability analysis model, building-land use correlation model
					Analyze the classification of land cover and divide it into state-owned allocated land, stated-owned transferred land	Land cover status, RS data	Scenario analysis, overlay analysis	ArcGIS (Analysis Tools), Erdas, Envi	Land use suitability analysis model, land use evolution analysis model, Beijing city spatial development analysis
					Analyze the approval materials of land use and divide it into approved and constructed, approved but not constructed, not	Land use approval data over the years(two certificates and one book), RS data	Scenario analysis, overlay analysis	ArcGIS (Analysis Tools), Erdas, Envi	Land use permit analysis model
				Population and employment	Analyze the size of population and employment, population structure, population density, population layout etc.	Population data over the years(permanent resident population, temporary resident population; population with Hukou, floating population; urban population, rural population) and its detailed constitution(age, gender, education, career); land use status over the	Regression analysis, scenario analysis, trend analysis	SPSS, ArcGIS (Analysis Tools)	Predicting gross population model, spatial distribution of population prediction model
				Transport infrastructure	Statistically analyze the current conditions of transport infrastructure and	Urban road network, transport infrastructure, household OD survey	Scenario analysis, trend analysis	ArcGIS (Analysis Tools)	Road network structure evaluation model, land use and traffic integration model, 交

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
				Municipal infrastructure	Collect data of water supply, water sewage, flood prevention, electricity supply, gas supply, heat supply, telecommunications	Municipal infrastructure	Scenario analysis , trend analysis	ArcGIS (Analysis Tools)	Land use and municipal integration model
				Antique resources	Collect and analyze the amount, layout, grade, preservation requirement of the antique resources and determine the	Level, distribution, conservation scope and burying area of historical relics	Scenario analysis , trend analysis	ArcGIS (Analysis Tools)	Cultural relic protective range analysis model, land use suitability analysis model
			Overall layout and scale control	Development direction and function orientation	Determine the dominant function of blocks according to the function orientation	Land use status, distribution of important functional areas, public service facilities, socioeconomic status	Multi-attribute evaluation, overlay analysis	ArcGIS (Analysis Tools)	Location analysis model, land use suitability analysis model
				Scale control of land use and construction	Determine the construction intensity in the block and propose the scale of land use and residential buildings according to the analysis of the comprehensive economic strength,	Land use status, current status and plan of public service facilities, transport infrastructure and municipal infrastructure(including distribution, scale, level, capacity, etc.), ecological environment	Scenario analysis , overlay analysis, neighbor analysis	ArcGIS (Spatial Analyst Tools) , what if	Population bearing capacity analysis model, planning index calculation model, building - land use correlation model
				Scale control of population and employment	Determine the amount of residence and employment in the block according to the analysis of the comprehensive economic strength, function orientation, transport bearing capacity, public service	Land use status, current status and plan of public service facilities, transport infrastructure and municipal infrastructure(including distribution, scale, level, capacity, etc.) , ecological environment	Scenario analysis , overlay analysis, neighbor analysis	ArcGIS (Spatial Analyst Tools) , what if	Population bearing capacity analysis model, predicting gross population model, spatial distribution of population prediction model, employment and industrial
			Land use layout and the arrangement of the three types of infrastructure	Land use layout	Determine the residential land, the settlement land for village relocation and its auxiliary land for educational facility	Land use status, transport infrastructure, municipal infrastructure, constraining elements	Scenario analysis , overlay analysis, neighbor analysis	Control regulation integration system, ArcGIS (Analysis Tools)	Residential location choice model, job location choice model
				Urban public infrastructure	Determine the scale of land for facilities of education, health care, culture, sports, social welfare, administrative office etc.	Current status of public service facilities(distribution, scale, level and capacity) and land use	Genetic algorithm, artificial neural network, integer programming	ArcGIS (Spatial Analyst Tools) , what if	Public service facilities Comprehensive model, public service facilities location selection model
				Transport and municipal infrastructure	Determine the standard, amount and location of different kinds of auxiliary transport and municipal facilities	Current status of transport and municipal infrastructure(distribution, scale, level and capacity) and land use	Genetic algorithm, artificial neural network, integer programming, simulated annealing	ArcGIS (Spatial Analyst Tools) , what if	Traffic facilities location model
				Urban security infrastructure	Determine the land use scale, service scope and scale of population in service of fire control and urban emergency shelters	Current status of urban security infrastructure(distribution, scale, level and capacity) and land use	Genetic algorithm, artificial neural network, integer programming, simulated annealing algorithm	Control regulation integration system, ArcGIS (Spatial Analyst Tools)	Disaster distribution character and inducement analysis model
				Urban environment and greenland system	Determine the distribution, scale and spatial layout of urban public green space	Public green space, protection green space, landscape and famous scenery, natural reserves, forest park, forest land, wetland, environment monitoring data, land cover status, transport	Density core analysis, cluster analysis, radiant section analysis	BICP 3D, ArcGIS (Spatial Analyst Tools) , EcoTect	Wind environment evaluation model, landscape index comprehensive evaluation model, visibility analysis model, light pollution
		Regulatory detailed plan of lot layer	Current situation analysis	Location analysis	Analyze the favorable factors and constraints of development in the context of the location	Administrative boundary, DEM, socioeconomic, regional transport system, key infrastructure, land use	Multi-attribute evaluation	ArcGIS (Spatial Analyst Tools)	Status comprehensive analysis model, location analysis model
				Natural resources	Determine the type and range of blocks in need of preservation and control through a comprehensive consideration of	Natural resources, topography and geomorphology, DEM, engineering geological conditions	Slope analysis, 3D analysis, overlay analysis	ArcGIS (3D Analyst Tools)	Basic topography analysis model, drainage basin partition model
				Land use and construction conditions	Analyze the current situation of land use and building layout, delimit the land use for reconstruction and new construction	Land use status, RS data, topographic map(including building model)	Scenario analysis , overlay analysis	ArcGIS (Analysis Tools) , Erdas, Envi	Land use suitability analysis model, building -land use correlation model
					Analyze the classification of land cover and divide it into state-owned allocated land, stated-owned transferred land, collective construction land and collective farm land	Land cover status, RS data	Scenario analysis , overlay analysis	ArcGIS (Analysis Tools) , Erdas, Envi	Land use suitability analysis model, land use evolution analysis model, beijing city spatial development analysis model
					Analyze the approval materials of land use and divide it into approved and constructed, approved but not constructed, not	Land use approval data over the years(two certificates and one book), RS data	Scenario analysis , overlay analysis	ArcGIS (Analysis Tools) , Erdas, Envi	Land use permit analysis model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
				Population and employment	Analyze the size of population and employment, population structure, population density, population layout etc.	Population data over the years(permanent resident population, temporary resident population; population with Hukou, floating population; urban population, rural population)	Regression analysis, scenario analysis , trend analysis, population redistribution theory	SPSS, ArcGIS (Spatial Analyst Tools)	Predicting gross population model, spatial distribution of population prediction model
				Transport infrastructure	Statistically analyze the current conditions of transport infrastructure and	Urban road network, transport infrastructure, household OD survey	Scenario analysis , trend analysis	ArcGIS (Analysis Tools)	Road network structure evaluation model, land use and traffic integration model, 交
				Municipal infrastructure	Collect data of water supply, water sewage, flood prevention, electricity supply, gas supply, heat supply, telecommunications	Municipal infrastructure	Scenario analysis , trend analysis	ArcGIS (Analysis Tools)	Land use and municipal integration model
				Antique resources	Collect and analyze the amount, layout, grade, preservation requirement of the antique resources and determine the	Level, distribution, conservation scope and burying area of historical relics	Scenario analysis , trend analysis	ArcGIS (Analysis Tools)	Cultural relic protective range analysis model, land use suitability analysis model
			Function determination and scale control	Dominant function	Determine the dominant function of blocks according to the function orientation	Land use status, distribution of important functional areas, public service facilities, socioeconomic status	Multi-attribute evaluation, overlay analysis	ArcGIS (Analysis Tools)	Location analysis model, land use suitability analysis model
				Scale control of land use and construction	Determine the construction intensity in the block and propose the scale of land use and residential buildings according to the analysis of the comprehensive economic strength, function orientation, transport bearing capacity, public service facility bearing capacity, municipal facility bearing capacity and environmental	Land use status, current status and plan of public service facilities, transport infrastructure and municipal infrastructure(including distribution, scale, level, capacity, etc.), ecological environment capacity	Scenario analysis , overlay analysis, neighbor analysis	ArcGIS (Spatial Analyst Tools) , what if	Population bearing capacity analysis model, planning index calculation model, building - land use correlation model
				Scale control of population and employment	Determine the amount of residence and employment in the block according to the analysis of the comprehensive economic strength, function orientation, transport bearing capacity, public service	Land use status, current status and plan of public service facilities, transport infrastructure and municipal infrastructure(including distribution, scale, level, capacity, etc.) , ecological environment	Scenario analysis , overlay analysis, neighbor analysis	ArcGIS (Spatial Analyst Tools) , what if	Population bearing capacity analysis model, predicting gross population model, spatial distribution of population prediction model, employment and industrial
			Plan scheme	Land boundary and usage	Divide the planning area through considering the land ownership, topography and geomorphology and a rational density of road network; determine the use of	Land use status, RS data, cadastre, planning result of upper level, previous planning results	Scenario analysis	Control regulation integration system, ArcGIS (Spatial Analyst Tools)	Land use Function layout analysis model
				Planning control index	Determine the floor area ratio, building height, building density, population density, green space ratio, open space ratio, direction of entrance and exit, building setback restriction	Current status and plan of land use	Scenario analysis	Control regulation integration system, ArcGIS (Spatial Analyst Tools)	Planning index calculation model, building -land use correlation model
				Control index of the three infrastructure	Determine the capacity and service scope of the three infrastructure (public service	Current status and plan of land use, planning result of upper level		Control regulation integration system, ArcGIS (Analysis Tools)	Population bearing capacity analysis model, planning index calculation model, building -
				Control of the five lines	Determine the control scope and control requirement of the five lines (the green line, the blue line, the yellow line, the purple line, the red line)	Current status and plan of land use, transport infrastructure, municipal infrastructure, green space plan, conservation plan of historical relics	Overlay analysis, radiant section analysis	Control regulation integration system, ArcGIS (Analysis Tools)	Planning control Comprehensive model
		Urban design	Spatial arrangement	Strategy determination of urban design	Determine the landscape control area, landscape control belt, landscape control node and their control scope; determine the urban design strategy	Landscape control area, landscape control belt, landscape control node, height zoning	Clark model, wilson model, newton model	ArcGIS (Spatial Analyst Tools)	Location analysis model
				Key scenery area identification	Delimit the key distinctive area for focused development, such as the central commercial area, administrative area, historic conservation area, waterfront area and walking landscape area, according to the level	Land use status, land use plan, public service infrastructure, industrial layout, building distribution	Density core analysis, radiant section analysis	BICP 3D, ArcGIS (Spatial Analyst Tools)	Regional characteristic analysis model, location analysis model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Spatial pattern	Height control	Determine the zoning of building heights, landmark and skyline. Determine the upper limit of the building height in each zone	Land use status, land use plan, building distribution	Scenario analysis, overlay analysis, neighbor analysis, isovist analysis	BICP 3D, Control regulation integration system, ArcGIS (Spatial Analyst Tools), EcoTect, SketchUp	Sunshine analysis model, wind environment evaluation model, visibility analysis model
				Open space	Determine public green spaces, important streets, city squares	Public green space, urban square, street green space	Density core analysis, radiant section analysis	BICP 3D, ArcGIS (Spatial Analyst Tools)	Wind environment evaluation model, landscape index comprehensive evaluation model
				Pedestrian system and street interface design	Determine the street section and way of road greenization	3D architecture model		BICP 3D, SketchUp	
				Architecture style guidance	Make out guiding proposals for the control of building scale, size, form and colour	3D architecture model		BICP 3D, SketchUp	
	Municipal plan	Water supply plan	Water consumption analysis	Water demand forecast	Forecast the water demand in the planned land	Forecasted population scale, water consumption of different types of consumers, planned land use type, land area, building area, floor area ratio, green space ratio, industry standard and regulation	Population projection method, floor-area prediction, linear regression method, time series analysis		
				Water supply analysis	Analysis the resource and amount of water supply in the land	Amount of water resource, amount of exploitable water resource, current water source quality, water supply mode, water supply amount	On-site survey		
				Water resource balancing	Balance the water supply and water demand in the planned year. If there is a contradiction, propose measures to solve it	Planned water demand, water supply, current scale of water plant	Balance calculation		
			Water source plan	Selection of water source	Select the water source for supply according to the balancing result	Planned water demand, water supply, current amount of water source	Balance calculation		
			Water supply plant plan	Layout and scale determination of water supply plant	Determine the layout and scale of water supply plant according to the balancing result and the amount of supply from the water source	Current scale of water plant, water resource distribution, planned land area			
			Water pipeline plan	Layout and scale plan of water pipeline	Make out the route selection and scale determination for the water pipeline according to the balancing result, the situation of the planned land and planned water plant	Current and planned location and scale, planned road network, planned land use, water resource distribution	Hydraulic calculation		
			Water supply network plan	Layout and scale determination of water supply network	Arrange the water supply network according to the balancing result and layout and scale of water supply plant; determine the reasonable size of the water pipeline by the calculation of pipe network hydraulic balance according to the water use demand and pipeline economic flow velocity of each node on the pipe network	Basic geography, water consumption in node areas, water consumption in concentration, water supply of water plant, water supply quotient in peak hour, current water supply pipeline, road class, time sequence of road construction	Node hydraulic adjustment method	NetSimu, Bentley Haestad, EPANet	Water distribution network model
			Pumping station plan	Layout and scale determination of pumping station	Choose the mode of water supply by zone or by hydraulic pressure according to the calculation of water supply network hydraulic balance; determine the layout, pump lift and flow of the pumping stations according to optimized calculation	Basic geography, water consumption in node areas, water consumption in concentration, water supply of water plant, water supply quotient in peak hour, current water supply pipeline, road class, time sequence of road construction	Node hydraulic adjustment method	NetSimu, Bentley Haestad, EPANet	Water distribution network model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
		Rain water drainage plan	Rainwater drainage pipeline plan	Plane and vertical layout and scale determination of rainwater drainage pipeline	Based on the division of drainage area, plan the layout of rainwater drainage pipeline according to the distribution characteristics of road and topography; determine the vertical design and scale of rainwater pipeline according to the splice of the flood level with the lower watercourse, precipitation and runoff data and plan standards	Basic geography, current rainwater pipeline, current other municipal pipeline, splice of flood water with the lower watercourse, pavement of the floor, storm intensity formula, rainfall hydrograph, time sequence of road construction	Formula rational method, saint-Venant Equations, unsteady hydraulic model, overland flow model	MDPAP, hongye outdoor water supply and sewerage design software design, MIKE, Xpsoftware, SWMM, InfoWorks	Drainage model
			Rainwater drainage pumping station plan	Plane layout and scale determination of rainwater drainage pumping station	Based on the division of drainage area, plan the layout of rainwater pumping station according to the distribution characteristics of road and topography; determine the scale of rainwater pumping station according to the precipitation and runoff data and drainage standard	Basic geography, current rainwater pipeline, current other municipal pipeline, scale of pipeline in the lower reach, pavement of the floor, storm intensity formula, rainfall hydrograph, time sequence of road construction	Formula rational method, saint-Venant Equations, unsteady hydraulic model, overland flow model	MDPAP, hongye outdoor water supply and sewerage design software design, MIKE, Xpsoftware, SWMM, InfoWorks	Drainage model
		Sewage drainage plan	Sewage quantity forecast	Scale determination of sewage drainage	Determine the sewage drainage scale according to the forecasted water demand and the conversion	Planned land use, forecasted domestic water consumption, forecasted water consumption of public buildings,	Commutation law		
			Sewage plant plan	Layout and scale determination sewage plant	Determine the layout and scale of sewage plant according to the planned land use and forecasted sewage drainage	Basic geography, planned land use, forecasted sewage drainage			
			Sewage pipeline plan	Plane and vertical layout and scale determination of sewage pipeline	Plan the layout of sewage drainage pipeline according to the distribution characteristics of road and topography; determine the vertical design and size of sewage pipeline according to the sewage drainage standard	Basic geography, current and planned sewage pipelines, current other municipal pipelines, road class, time sequence of road construction	Formula rational method, saint-Venant Equations, unsteady hydraulic model	MDPAP, hongye outdoor water supply and sewerage design software design, MIKE, Xpsoftware, SWMM, InfoWorks	Drainage model
		Reclaimed water use plan	Water consumption analysis	Water demand forecast	Forecast the water demand in the planned land	Planned population scale, water consumption of users of different types, planned land use area, land use area, building area, floor area ratio, green space ratio, industry standard and regulations	Population projection method, floor-area prediction, linear regression method, time series analysis		
				Water supply analysis	Analyze the water supply in the planned land	Total amount of sewage resourcization and current reclaimed water supply	On-site survey		
				Water resource balancing	Balance the water supply and water demand in the planned year. If there is a contradiction, propose measures to solve it	Planned water demand, water supply, reclaimed water plant	Balance calculation		
			Reclaimed water source plan	Analysis of reclaimed water resource from sewage	Plan the source of reclaimed water according to the balancing result of water supply and demand	Planned water demand, water supply, current water source supply	Balance calculation		
			Reclaimed water plant plan	Layout and scale determination of reclaimed water plant	Determine the layout and scale of the reclaimed water plant according to the balancing result of water supply and demand, and the amount of water source supply	Current size of reclaimed water plant, water resource distributed, planned land area			
			Reclaimed water pipeline network plan	Layout and scale determination of reclaimed water pipeline network	Arrange the reclaimed water supply network according to the balancing result and layout and scale of reclaimed water plant; determine the reasonable size of the reclaimed water pipeline by the calculation of pipe network hydraulic balance according to the water use demand and pipeline economic flow velocity of each node on the pipe network	Basic geography, water consumption in node areas, water consumption in concentration, water supply of reclaimed water plant, water supply quotient in peak hour, current reclaimed water supply pipeline, road class, time sequence of road construction	Node hydraulic adjustment method	NetSimu, bentley haestad, EPANet	Water distribution network model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Pumping station plan	Layout and scale determination of pumping station	Choose the mode of reclaimed water supply by zone or by hydraulic pressure according to the calculation of reclaimed water supply network hydraulic balance; determine the layout, pump lift and flow of the pumping stations according to optimized calculation	Basic geography, water consumption in node areas, water consumption in concentration, water supply of reclaimed water plant, water supply quotient in peak hour, current reclaimed water supply pipeline, road class, time sequence of road construction	Node hydraulic adjustment method	NetSimu, Bentley Haestad, EPANet	Water distribution network model
		Flood control and water system plan	Watershed analysis	Watershed boundary determination	Determine the watershed boundary according to the natural terrain and layout of the watershed	Basic geography, current and planned water system layout, land leveling	On-site survey, drawing analysis, layout synthetic operation		
			Standard and function determination	Standard formulation of flood control, design, water quality and water function	Determine the standard of flood control and corresponding water system design, water quality and water function	Basic geography, function plan of urban and rural land use, historical flood data, water function plan, water quality standard	Comprehensive analytical method, empirical analysis method, layout synthetic operation		
			Hydrological computation	Calculation of standard floods of different recurrence intervals	Calculate the flow, process and total amount of flood of different recurrence intervals according to the runoff yield and concentration conditions of the watershed	Underlying surface, historical flood data, precipitation, basin morphology, basic geography, function plan of urban and rural land use, rainwater pipeline parameter, structure parameter, hydrological parameter	Empirical formula method, rational formula method, physical simulation method, mathematical simulation method	MIKE, Xpsoftware, HEC, SWMM, InfoWorks, multipoint inflow confluence calculation software	Drainage model
			Vertical and cross section plan	Plane and vertical plan scheme of watercourse	Determine the plane and vertical plan scheme of watercourse according to the land use condition and planned watercourse function, combined with other boundary conditions	Basic geography, function plan of urban and rural land use, rainwater pipeline parameter, other pipeline and architecture parameter, structure parameter	Hydraulic calculation, trial method, empirical analysis method	assistant design software	
			Layout plan	Layout plan of water system	Determine the layout plan of water system according to the urban and rural land use function plan and land use condition	Basic geography, function plan of urban and rural land use, hydraulic structure location, bridge and dam locations, location of roads and buildings facing rivers	Trial method, empirical analysis method	assistant design software	
			Hydraulic computation	Hydraulic computation according to the vertical and layout plan of watercourse, and modification of vertical, cross section and layout plan according to feedback	Compute the hydraulic elements like flood process velocity, flood peak velocity, water level, water depth, flow pattern, according to the vertical and layout plan of watercourse, and modify the vertical, cross section and layout plan according to feedback, until the design satisfies the requirements in the plan	Basic geography, precipitation parameter, hydraulic structure parameter, bridge and dam parameter, rainwater drainage precipitation, hydrological parameter	Theoretical analysis, dimension analysis method	MIKE, Xpsoftware, HEC, SWMM, InfoWorks	Drainage model
			Flood storage plan	Analysis of the influence and loss of flood submergence; formulation of flood storage plan	Make out flood storage plan for standard flood or exceeding standard flood according to the hydrological computing result and the flood dispatching scheme in the upper and lower reaches of the basin	Basic geography, precipitation parameter, hydrological parameter, drainage agreement crossing administrative regions, plan standard	Comprehensive analytical method, flood simulation		
			Sewage interception and water quality improvement plan	Formulation of sewage interception and water quality improvement plan	Make out sewage interception and water quality improvement plan according to the survey on the sewage drainage into the water system and the dirt holding capacity	Basic geography, hydrological parameter, sewage drainage data, water function zoning and water quality standard, current and planned sewage collection and treatment system	Comprehensive analytical method, standard and experience incorporation method, water quality simulation		
		Heat supply plan	Heating mode research	Investigation of the local energy structure, energy development policy; determination of energy supply, maintenance and usage	Unless the energy structure is converted, the local plan should obey the energy development policy that upper plan has determined	Master plan, strategic plan, energy development plan			

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Research and analysis of current heating situation	Investigation of basic data of current heating mode, facility and pipeline network; comparison and analysis of heating mode	Investigate the plan of current buildings in the planned area, and distinguish the buildings to be preserved from to be reconstructed; collect the heating mode, heating facility and pipeline network of current buildings, and compare them with the planned heating mode, analyze the rationality and problems of current heating mode	Current heating facility and pipeline			
			Heating load forecast	Heating load forecast	Forecast the heating load of the planned scale in the planned area	Energy-saving standard, heat load index, building scale of planned buildings	Load-density method		
			Heating mode research	Determination of the heating mode in the planned area	Based on the heating mode research, current situation survey and the proprietors' opinion, comprehensively consider the demand for cooling and heating load in the planned area and determine the heating mode	Forecasted cooling and heating load and its characteristics of planned buildings	Balance calculation		
			Heating facility plan	Heating facility plan, like the plan of heating plant, boiler room, etc.	Plan the heating facility according to the heating mode research, and determine the layout and scale of heating facilities according to the forecasted heating load	Forecasted cooling and heating load and heat supply facility selection	Balance calculation		
			Heat exchange station plan	Layout plan of heat exchange station	Make out the layout of heat exchange station according to the distribution and load of the heat consumers	Heat user distribution and building scale	Balance calculation		
			Heating network plan	Heating network plan for the central heating supply scheme	Arrange the heating pipeline network along the urban roads for the central heating supply scheme	Heating load of heat exchange station	Hydraulic calculation		
		Gas supply plan	Investigation on current gas supply facilities	Investigation on the current gas supply facilities and capacity and pipeline network construction around the planned area	Investigate the gas supply and indemnification in the planned area and its surrounding areas, investigate the distribution and capacity of gas supply facilities, investigate the gas supply pipeline network construction, the current consumer development and rate of gasification	Total amount of regional gas resource, current layout of gas supply facilities, current gas supply facility capacity			
			Gas supply mode	Research on gas supply mode	Which gas supply mode should be adopted: pipeline gas, liquefied natural gas or liquefied petroleum gas	Total amount of regional gas resource, current layout and capacity of gas supply facilities, planned amount of gas source	Gas equilibrium analysis		
			Gas consumption forecast	Determination of the yearly gas consumption and peak-hour gas consumption in the planned area	Estimate the yearly gas consumption and peak-hour gas consumption in the planned area with corresponding building amount and population scale according to the gas supply mode	Gasification ratio, gas use index, imbalance quotient	Unbalanced coefficient method, coincidence factor method, heat load calculation		
			Pressure range of gas supply	Determination of the pressure range of pipeline gas supply	Choose suitable pressure range for the pressure of pipeline gas supply according to the forecasted gas demand	Gas use amount, gas demand			
			Gas supply facility plan	Scale and layout determination of gas gate station, regulator station, tank station, etc.	Determine the gas supply facilities, including gate station, regulator station, tank station, etc. according to the forecasted gas demand, the pressure range chosen and the upper level plan; determine the land and location for the stations on the planning map according to the land-saving index	Regional total amount of gas source, current layout and capability of gas supply facilities, planned total amount of gas source	Gas equilibrium analysis		

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Gas supply network plan	Planning of gas supply network route and caliper for pipeline gas supply	Plan the gas supply pipeline network along the urban roads to satisfy the gas demand according to the forecasted gas demand and the layout of the planned gas supply facilities; delimit safety distance for the pipelines with high pressure range according to regulations	Gas use amount on each node	Hydraulic calculation		
		Electricity supply plan	Investigation on current electricity supply facilities	Current situation of important electricity transmission and distribution facility of high-voltage and medium-voltage in the planned area	Capacity, planned scale, current load, current elevated corridor, connection mode of high-voltage electricity transmission and distribution network, connection mode of high-voltage electricity transmission and distribution system. layout of medium-voltage electricity transmission and distribution facilities, connection mode of medium-voltage electricity transmission and distribution network, construction of power channel	Main voltage grade, number, distribution, capacity, designed scale, load ratio of electricity transformer substation, geographic connection figure of elevated corridor, number of electricity switching stations, construction route of power channel			
			Voltage grade	Determination of main voltage grade	Determine the voltage grade according to the electricity supply in the planned area	Current voltage grade of electricity supply system in the area			
			Power load forecast	Forecast of maximum power load	Choose suitable index and method and forecast the maximum power load according to the planned land use, building scale, population scale, economic development, etc. in the planned area	Planned land use, building scale, population scale, economic development	Load-density method, elastic coefficient method, unit consumption of product method, time series analysis		
			High-voltage distribution network plan	Plan and layout of high-voltage electricity transmission and distribution facility	Plan the voltage level of high-voltage electricity transformer substations, number, capacity and layout of transmission substations, the connections and geographic connections of high-voltage power network system, integrate the high voltage corridor	Common voltage grade of local power network, capacity of common electricity transformer substation, connection mode of high-voltage distribution network, control standard for elevated corridor	Power flow calculation, short-circuit current calculation		
			Medium-voltage distribution network plan	Plan and layout of medium-voltage electricity transmission and distribution facility	Layout of the medium-voltage electricity switching station, plan of power channel	Common electricity supply mode and connection mode of local medium-voltage distribution network	Power flow calculation, short-circuit current calculation		
		Telecommunication s plan	Current situation of communication bureaus and pipelines	Investigation on current situation of communication bureaus and pipelines in and around the planned area	Investigate the mechanism of communication bureaus, current layout of communication bureaus, capacity of switches, construction mechanism of communication pipeline facilities, layout of pipelines in the planned area and its surrounding areas	Capacity of switches and size of pipelines of the communication bureaus			
			Forecast of the number of users	Forecast of the number of telecommunications users	Choose the suitable index and forecast the necessary capacity of switches according to the planned land use, building scale, population scale and economic development	Planned land use, building scale, population scale, economic development			
			Communication bureau plan	Communication bureau plan	Plan the layout of communication bureaus according to the current situation and the forecasted number of users	Current capacity of communication bureaus	Analysis and optimization		
			Communication pipeline plan	Communication pipeline plan	Plan the communication pipelines according to the forecasted number of users, layout of communication bureaus and red line width of roads	Current communication pipelines, forecasted number of users, planned layout of communication bureaus, planned red line width and grade of roads	Optimization layout according to the red line of road		

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
		Cable network plan	Current situation of cable TV stations and pipeline network	Investigation on current situation of cable TV stations and pipeline network	Investigate the cable TV station and users in the planned area and its surrounding areas, and command the situation of the cable TV pipeline network in the surrounding areas	Users of cable TV station, cable TV pipeline network			
			Forecast of the number of users	Forecast of the number of cable TV users	Determine the cable TV user rate and forecast the number of cable TV users according to the land use, building scale, population scale and economic development in the planning	Planned land use, building scale, population scale, economic development, cable TV ratio			
			Cable TV station plan	Cable TV station plan	Plan the layout, land area and building scale of the cable TV stations	Current users of cable TV station, planned number of cable TV users	Analysis and optimization		
			Cable TV pipeline network plan	Cable TV pipeline network plan	Plan the cable TV pipeline network according to the forecasted number of cable TV users, urban road level and red line width of the planned roads	Planned cable TV pipelines, forecasted number of users, planned layout of cable TV stations, planned red line width and grade of roads	Optimization layout according to the red line of road		
		Environmental sanitation facility plan	Investigation on current situation	Investigation on current situation of domestic garbage disposal	Investigate the treatment for domestic garbage, kitchen waste and excrement in the planned area and its region, investigate the type and amount of the domestic garbage	Number, distribution and capacity of refuse transfer station, refuse processing plant, refuse collection station, etc.; type and daily amount of local domestic garbage generated			
			Forecast of the amount of refuse production	Forecast of the amount of domestic garbage, kitchen waste and excrement	Forecast the amount generated of domestic garbage, kitchen waste and excrement according to the land use, building scale and population scale, etc. in the planned area	Planned land use, building scale, population scale, daily amount of garbage generated			
			Environmental sanitation facility plan	Planning of refuse collection station, refuse transfer station and refuse processing plant	Plan the refuse collection station, refuse transfer station, refuse processing plant, sanitation parking lot, etc. according to the forecasted garbage generation with the current refuse treatment facility status	Planned amount of garbage generated, current capability and land area of current refuse processing facility			
			Refuse treatment mode	Treatment mode of domestic garbage	Plan the treatment for domestic garbage, kitchen waste, etc. according to the environmental sanitation facility plan				
	Transport plan	Transport demand forecast	Trip generation	Classification of trip purpose	Classify the total trips by different trip purposes	Household OD survey data, population and employment data, other supplementary survey data	Cluster analysis	SPSS, SAS, Excel	Trip-chaining analysis model
				Parameter calibration of trip generation	Calibrate the parameters by trip purpose	Household OD survey data, population and employment data, other supplementary survey data	Regression analysis, least squares method model, optimization theory	SPSS, SAS, Excel	Generation-attracting rate computing model
				Total number of trips generated	Calculate total number of trips by trip purpose or trip mode				Generation-attracting rate computing model
			Trip distribution	General cost between TAZs	General cost matrix between TAZs in the gravity model	Household OD survey data, population and employment data, other supplementary survey data	The shortest path Dijkstra algorithm	Cube, Trips	Comprehensive cost model
				Friction matrix calibration	Modified general cost matrix between TAZs in the gravity model	Household OD survey data, population and employment data, other supplementary survey data	Loop computation, doubly-constrained gravity model	Cube, Trips	
				OD matrix	Trips between TAZs of different trip purposes	Public transport IC card data	Loop computation, doubly-constrained gravity model	Cube, Trips	Bus IC card analysis model
			Mode split	General cost calculation of different transport modes	Calculate the general cost matrix between TAZs of different modes	Household OD survey data, population and employment data, other supplementary survey data	The shortest path Dijkstra algorithm	Cube, Trips	Road network equilibrium model, comprehensive cost model
				Proportion division among different transport modes	Mode split of trips between TAZs by general cost of different modes		Optimization theory, Logit model	Cube, Trips	
			Traffic assignment	Vehicle flow assignment on roads	Assign trips by cars on the roads	Planned road network	Equilibrium theory	Cube, Trips, Transus	Road network equilibrium model
				Passenger flow assignment on public transport	Assign trips by public transport on public transport routes	Planned public transport route network	Equilibrium theory	Cube, Trips, Vissim	Road network equilibrium model
		Urban road network plan	Current situation analysis	Current road construction conditions and problem analysis	Summarize the current problems to be solved in the plan	Population, number of vehicle owned, road construction status, road investment	Time series analysis, analytic hierarchy process, space syntax	Excel, MS Word, AxWoman	Status comprehensive analysis model, road network structure evaluation model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Urban road hierarchy plan	Urban expressway system plan	Propose the express system in the planned area	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model, Beijing transport strategy model
				Arterial road system plan	Propose the arterial road system in the planned area	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model
				Secondary trunk road system plan	Propose the secondary trunk road system in the planned area	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model
				Minor road system plan	Propose the minor road system in the planned area	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model
			Urban road red line plan	Red line plan of urban expressways	Propose the standard of red line width of urban expressways in the planned area	Urban expressway system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Red line plan of arterial roads	Propose the standard of red line width of arterial roads in the planned area	Arterial road system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Red line plan of secondary trunk roads	Propose the standard of red line width of secondary trunk roads in the planned area	Secondary trunk road system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Red line plan of minor roads	Propose the standard of red line width of minor roads in the planned area	Minor road system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
			Cross section plan	Cross section plan of urban expressways	Propose the cross section plan of urban expressways in the planned area	Urban expressway system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Cross section plan of arterial roads	Propose the cross section plan of arterial roads in the planned area	Arterial road system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Cross section plan of secondary trunk roads	Propose the cross section plan of secondary trunk roads in the planned area	Secondary trunk road system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Cross section plan of minor roads	Propose the cross section plan of minor roads in the planned area	Minor road system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
		Highway network plan	Current situation survey	Current highway construction conditions and problem analysis	Summarize the current problems to be solved in the plan	Current population, number of vehicle owned, road construction status, road investment	Statistical analysis method	Excel, SPSS	
			Highway hierarchy plan	Expressway system plan	Propose the route planning of expressway system	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model
				First class highway system plan	Propose the route planning of the first class highway system	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model
				Second class highway system plan	Propose the route planning of the second class highway system	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model
				Third class highway system plan	Propose the route planning of the third class highway system	Desire line of planned trips(generated from OD matrix), topography and geomorphology in planned area	Standard and experience incorporation method, fitting passenger flow method	ArcGIS (Spatial Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, basic topography analysis model
			Highway red line plan	Red line plan of expressways	Propose the standard of the width of expressway red line in the planned area	Expressway system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Red line plan of first class highways	Propose the standard for the red line of first class highways in the planned area	First class highway system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Red line plan of second class highways	Propose the standard for the red line of second class highways in the planned area	Second class highway system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Red line plan of third class highways	Propose the standard for the red line of third class highways in	Third class highway system	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools, Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
		Public transport plan	Current situation survey	Current public transport facility conditions and problem analysis	Problem analysis of public transport	Statistic data of public transport, including routes, size of stations, investment, passenger flow	Statistical analysis method	Excel, SPSS	

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Rail transit plan	Rail transit routes	Route and station location of the rail transit system	Planned corridor for passenger flow	Standard and experience incorporation method,	ArcGIS (Spatial Analyst Tools, Network Analyst Tools) ,	Networks optimization models, bus IC card analysis model
				Rail transit stations	Location and size of the rail transit stations	Current land use status, route and fleet of rail transit	Standard and experience incorporation method, optimization theory	ArcGIS (Analysis Tools) , AutoCAD	Traffic facilities location model
			Public transport station plan	Junction stations	Location and size of the junction stations	Upper-level plans of rail transit route network, rail, highway, urban key functional area, etc.	Optimization theory, fitting passenger flow method	ArcGIS (Analysis Tools, Network Analyst Tools) , AutoCAD	Traffic facilities location model
				Maintenance stations	Location and size of the maintenance stations	Upper-level plans of rail transit route network, rail, highway, urban key functional area, etc.	Optimization theory, fitting passenger flow method	ArcGIS (Analysis Tools) , AutoCAD	Traffic facilities location model
				Central stations	Location and size of the central stations	Upper-level plans of rail transit route network, rail, highway, urban key functional area, etc.	Optimization theory, fitting passenger flow method	ArcGIS (Analysis Tools, Network Analyst Tools) , AutoCAD	Traffic facilities location model
				Initial and terminal stations	Location and size of the initial and terminal stations	Upper-level plans of rail transit route network, rail, highway, urban key functional area, etc.	Optimization theory, fitting passenger flow method	ArcGIS (Analysis Tools) , AutoCAD	Traffic facilities location model
			Public transport route plan	Classification of public transport routes	Divide bus routes into different levels according to the transport demand	Passenger flow in plan and upper-level plans of key functional area and residential area	Standard and experience incorporation method, fitting passenger flow method, optimization theory	ArcGIS (Analysis Tools) , AutoCAD	Networks optimization models
				Bus rapid transit plan	BRT route	Planned corridor for passenger flow	Standard and experience incorporation method, fitting passenger flow method, optimization theory	ArcGIS (Analysis Tools) , AutoCAD	Networks optimization models
		Non-motorized traffic system plan	Current situation survey	Current non-motorized traffic facility conditions	Problem analysis of current non-motorized traffic facility	Bicycle parking data, pedestrian questionnaire	SWOT analysis	ArcGIS (Analysis Tools) , AutoCAD	
			Bicycle system plan	Bicycle lane plan	Bicycle lane width or special lane plan	Planned road network	Standard and experience incorporation method, the shortest path Dijkstra algorithm	ArcGIS (Analysis Tools) , AutoCAD	Networks optimization models
				Bicycle parking lot plan	Public bicycle parking lot plan	Bicycle demand	Standard and experience incorporation method	ArcGIS (Analysis Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Bicycle parking quota plan	Bicycle parking quota of residential building and public building	Total demand of bicycle transport	Standard and experience incorporation method		
			Pedestrian system plan	Street-crossing facility plan	Plan of overpass, underpass and street crossing	Planned road network	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model
				Pedestrian street plan	Pedestrian street plan of commercial use and leisure use	Upper-level land use plan for residence, public building and others; planned road network	Standard and experience incorporation method	ArcGIS (Spatial Analyst Tools) , AutoCAD	Location analysis model, land use suitability analysis model, networks optimization models
		Parking plan	Current situation survey	Investigation on current parking situations	Investigation and problem analysis of the parking of public, residential and public building areas	Current number, location and number of parking spaces of current public parking lots	Statistical analysis method	Excel, SPSS	
			Public parking lot plan	Total number of social public parking lots	Determine the total public parking number according to the population and transportation demand plan	Planned population scale, planned number of vehicle owned, planned amount of trip demand by car	Standard and experience incorporation method	Excel, SPSS	Parking-demand model
				Layout of public parking lots	Distribute the public parking lots according to the demand of parking	Planned land use, planned road network	Standard and experience incorporation method, optimization theory	ArcGIS (Spatial Analyst Tools) , AutoCAD	Traffic facilities location model
			Parking quota	Parking quota in residential areas	Propose the parking quota in residential areas according to the location of the residential area	Planned residential area and the amount of trip demand by car	Standard and experience incorporation method		Traffic facilities location model
				Parking quota in public building areas	Determine the parking quota according to the location and function of the public building	Planned location of public buildings and the amount of trip demand by car	Standard and experience incorporation method		Traffic facilities location model
				Parking quota in other areas	Propose the parking quota of cars according to the public service facilities	Planned public service facility and the amount of trip demand by car	Standard and experience incorporation method		Traffic facilities location model
		Gas station plan	Current situation survey	Investigation on current gas station situations	Current situation analysis and problem analysis	Current construction status, location and size of gas station	SWOT analysis	ArcGIS (Analysis Tools) , AutoCAD	
			Gas station plan	Total demand for gas stations	Forecast the total number of gas stations according to population, car quantity, trip demand of cars, etc.	Planned population scale, planned number of vehicle owned, planned amount of trip demand by car	Standard and experience incorporation method		Gas station demand forecasting

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
				Layout of gas stations	Layout, location and size of gas stations	Planned land use status that is sensitive to gas station	Standard and experience incorporation method, optimization theory	ArcGIS (Analysis Tools) , AutoCAD	Traffic facilities location model
	Special plan	Educational infrastructure plan	Current situation analysis	Overall situations	Analyze the overall situations of population structure, structure of student source, teachers, distribution of educational infrastructure, land use layout, etc.	Age structure of population over the years, scale and distribution of education infrastructure, land use plan, land use status	Multi-attribute evaluation, overlay analysis	ArcGIS (Spatial Analyst Tools) , Control regulation integration system	Location analysis model, status comprehensive analysis model, land use suitability analysis model
				Conditions of various types of educational infrastructure (junior high school, vocational senior school, primary school, kindergarten and nursery)	Comprehensively analyze indices of the educational infrastructure in the region, like the service scope, land area, land area per student, building area per student, school size, floor area	Scale and distribution of education infrastructure, student source data, land use plan, land use status	Multi-attribute evaluation, overlay analysis, radiant section analysis, neighbor analysis	ArcGIS (Spatial Analyst Tools) , Control regulation integration system	Status comprehensive analysis model, public service facilities Comprehensive model
			Plan scheme	Land use and construction determination	Propose the standard for account of the floor area ration, building height and green space ratio	Land use plan, land use status, education infrastructure plan of upper level and larger scope	Scenario analysis , overlay analysis, neighbor analysis	ArcGIS (Spatial Analyst Tools) , what if	Population bearing capacity analysis model, planning index calculation model, building - land use correlation model
				Measure proposing of plan adjustments	Analyze the characteristics, requirement and problems of the educational infrastructure based on the analysis of current situation; divide the educational infrastructure into different	Age structure of population over the years, scale and distribution of education infrastructure, land use plan, land use status	Scenario analysis , overlay analysis, neighbor analysis	ArcGIS (Spatial Analyst Tools) , what if	Public service facilities Comprehensive model
				Overall situation analysis	Compare the current situation and the plan in the aspect of the total land area, land area per school and number of the educational infrastructure.	Scale and distribution of education infrastructure of current status, in plan and in adjustment of plan	Overlay analysis	ArcGIS (Spatial Analyst Tools) , what if	Location analysis model
		Fire-fighting infrastructure plan	Current situation analysis	Overall situations	Analyze the current amount, size, level, type, and distribution of fire brigades and fire stations; summary the problems of their construction, utilization and	Number, size, level, type and distribution of fire brigade and fire station	Multi-attribute evaluation, overlay analysis	ArcGIS (Spatial Analyst Tools) , what if	Location analysis model, status comprehensive analysis model, public service facilities Comprehensive model, disaster distribution
				Fire occurrence situations	Comprehensively analyze the history, distribution, level, loss, cause of fires in the area in planning, and their	Historical data of fires	Multi-attribute evaluation	ArcGIS (Spatial Analyst Tools) , what if	Status comprehensive analysis model, public service facilities Comprehensive model, disaster distribution
				Analysis of construction standards of fire brigade and fire station	Analyze the current construction standard that MHURD and the fire department of MPS, summarize the regulations and requirements on the construction of fire brigades	Number, size, level, type and distribution of fire brigade and fire station		Excel	Status comprehensive analysis model
			Plan scheme	Service scope and level of fire brigade and fire station	Determine the scope of the plan; the responsible area, level and classification of fire brigade and fire station	Land use status, land use plan, distribution of fire brigade and fire station	Density core analysis, radiant section analysis	ArcGIS (Spatial Analyst Tools) , what if	Public service facilities Comprehensive model
				Land use layout of fire brigade and fire station	Determine the specific requirements of the fire brigade and fire station plan and implement them in the planned	Land use status, land use plan, population	Density core analysis, radiant section analysis	ArcGIS (Spatial Analyst Tools) , what if	Land use suitability analysis model, public service facilities Comprehensive model, land use Function
				Regulatory quota of fire brigade and fire station	Determine indices in the regulatory plan like land area, building area, floor area ratio, building height, etc. of fire	Land use status, land use plan, regulatory detailed plan of upper level and larger scope		ArcGIS (3D Analyst Tools) , what if	Land use suitability analysis model, public service facilities Comprehensive model, land use Function
		Public service infrastructure plan							
		Public security infrastructure plan							
		Municipal special plan							
		Transport special plan							
		Historic city conservation plan							
		Underground spatial plan							

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
		Resource plan and environmental plan							
		Housing plan							
		Land cover relevant plan							
		Other special plans							
Plan evaluation	Master plan evaluation	City master plan evaluation	Population	Analysis on current population scale situation	The current situation of urban population scale in different categories; the relationship between population structure and urban function; the spatial distribution of population; the relationship between population and urban carrying capacity; etc.	Population data over the years in yearbook, administrative boundary, plan boundary, land use status, natural resource, land use plan	Synthetic growth-rate method , exponential growth model	ArcGIS (Spatial Analyst Tools) , SPSS	Status comprehensive analysis model
				Population scale forecast	Forecast the future trend of population change, including residence and employment, based on the current situation of urban population scale	Population data over the years in yearbook, administrative boundary, plan boundary, land use status, natural resource, land use plan	growth-rate method (synthetic growth-rate method , exponential growth model, regression analysis) , correlation analysis, resource&environment capacity analysis	ArcGIS (Spatial Analyst Tools) , SPSS	State quo and planning analysis and comparison model, predicting gross population model
			Industrial development	Current situation of overall industry development	The total economic amount, per-capita economic amount and percentage of the three industries; the adjustment of structure in each industry; the benefit analysis of industry; comparison with industries domestic and abroad	Economic data over the years in yearbook, administrative boundary, plan boundary, land use status, land use plan	Regression analysis, correlation analysis, input-output analysis	ArcGIS (Spatial Analyst Tools) , SPSS, Excel	State quo and planning analysis and comparison model, input-output model
				Current situation of industry spatial layout	The spatial layout and trend of spatial agglomeration and dispersion of the three industries; the influence of key industrial zones and special industrial cluster; the guidance of planning to industry development	Economic data over the years in yearbook, administrative boundary, plan boundary, land use status, land use plan	Cluster analysis, neighbor analysis, radiant section analysis, correlation analysis, input-output analysis	ArcGIS (Spatial Analyst Tools) , SPSS, Excel	Industry location selection model
			Urbanization and urban-rural integration	Analysis of current urbanization situation	Analyze the level and characteristics of urbanization in the aspect of population and land use, urban-rural gap, urban system, etc.	Data over the years in yearbook, administrative boundary, plan boundary, land cover status, land use plan	Cluster analysis, neighbor analysis, radiant section analysis, regression analysis	ArcGIS (Spatial Analyst Tools) , SPSS, Excel	Urban-rural integration analysis model
			Urban spatial arrangement	City size	The overall spatial change in city size(including population, construction land, green belt, etc.); the relationship between urban construction and urban construction circle as well as key development regions	Data over the years in yearbook, administrative boundary, plan boundary, land cover status, land use plan, plan approval status	Multi-attribute evaluation, scenario analysis	ArcGIS (Spatial Analyst Tools) , SPSS	Location analysis model, state quo and planning analysis and comparison model
				Functional structure	The current situation analysis of the three types of land use of residence, public service facility and industrial warehouse in each spatial ring, including the amount and spatial distribution	Administrative boundary, plan boundary, land use status, land cover plan, plan approval status	Multi-attribute evaluation, scenario analysis	ArcGIS (Spatial Analyst Tools) , Excel	Urban spatial morphology structure assessment model
				Comprehensive benefits	Comprehensive analysis on the land use and social economic development in each ring, including compactness and productivity of land use	Socioeconomic data over the years in yearbook, administrative boundary, plan boundary, land use status, land use plan, plan approval status	Regression analysis, correlation analysis, input-output analysis	ArcGIS (Spatial Analyst Tools) , SPSS	Input-output model, urban land comprehensive benefit assessment model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
				Planned stock of land	Analyze the rate of usage and the stock for development on urban land use in each ring; analyze the amount of land alteration	Administrative boundary, plan boundary, land cover status, land use plan, plan approval status		ArcGIS (Spatial Analyst Tools) , Excel	
			Transport system	Current situation investigation on comprehensive transport system	Investigate on the current situation of transport demand, transport operation, implementation of transport strategy, implementation of specific transport	Yearbook data over the years, transport data, land use status, land use plan	Document surveys, standard and experience incorporation method, spatial analysis, cluster analysis	ArcGIS (Spatial Analyst Tools) , SPSS, Cube	Land use and traffic integration model
				Problem analysis on current implementation situation of comprehensive transport system	Problem analysis in the aspect of the transport demand and transport operation, transport operation, implementation of transport strategies in the aspect of the current implementation situation of urban comprehensive transport system	Yearbook data over the years, transport data, land use status, land use plan	Document surveys, doubly-constrained gravity model, Logit model, cluster analysis	ArcGIS (Spatial Analyst Tools) , SPSS, Cube	Land use and traffic integration model
			Municipal infrastructure	Current situation investigation on plan implementation	Analyze the basic situation of the implementation of master plan in the aspect of exploitation and utilization of water resource and energy, accomplishment of compulsive content in master plan, accomplishment of overall target of main industries, development of main industries	Yearbook data over the years, municipal data, land use status, land use plan	Correlation analysis, regression analysis	SPSS, ArcGIS (Spatial Analyst Tools)	Land use and traffic integration model
				Problem analysis on plan implementation	Check the problems in the plan implementation from the structure and supply capability of resources and energy, factors like deployment, management, policy, significant issues, etc. and administrative bearing capacity	Yearbook data over the years, municipal data, land use status, land use plan	Scenario analysis , municipal bearing capacity analysis	ArcGIS (Spatial Analyst Tools)	Land use and traffic integration model
			Ecological environment	Current situation investigation on plan implementation	Investigate on the implementation of the master plan and the dynamic change in ecological environment according to the master plan	See the ecological environment part in the master plan section	Correlation analysis, regression analysis	ArcGIS (Spatial Analyst Tools) , SPSS	Bearing capacity analysis model
				Problem analysis on plan implementation	Analyze the main achievement, problems and the origin of problems of the implementation of the main ecological environment conservation plan in the city region and the urbanized area	See the ecological environment part in the master plan section	Bearing capacity analysis model	ArcGIS (Spatial Analyst Tools) , SPSS	Bearing capacity analysis model
			Housing	Current situation investigation on plan implementation	Measure the level of completion of the goals in the master plan and related special plans; analyze the spatial layout of housing and indemnificatory housing implemented	Yearbook data over the years, land use status, land use plan, plan approval	Neighbor analysis, overlay analysis	ArcGIS (Overlay, Buffer) , Excel	Real estate price model, residential location choice model, real estate site choice model
				Evaluation on plan implementation	Establish the evaluation system on the implementation of the housing planning, in the four main aspects of goal evaluation, system evaluation, layout evaluation and policy evaluation	Yearbook data over the years, land use status, land use plan, plan approval	Spatial analysis, correlation analysis	ArcGIS (Analysis Tools) , Excel	Real estate price model, residential location choice model, real estate site choice model

Level 1	Level 2	Level 3	Level 4	Planning element	Descriptions	Data	Method	Software	Model
			Historic city	Current situation investigation on plan implementation	Calculate the proportion of implementation in the overall goal in the topic of historic cultural city preservation, and analysis qualitatively the implementation of overall projects and special projects in the master plan	Yearbook data over the years, old city conservation data, land use status, land use plan, plan approval		ArcGIS (Spatial Analyst Tools) , Excel	
			Urban comprehensive disaster mitigation	Current situation investigation on plan implementation	Calculate the implementation of the compulsive content in the master plan and the land for facilities in urban disaster mitigation plan	Yearbook data over the years, land use status, land use plan, disaster mitigation data		ArcGIS (Spatial Analyst Tools) , Excel	