

IFLA AAPME Awards 2024

Award Categories - Analysis and Planning (Unbuilt Category)

PROJECT BINDER

A Flowing Center

——Central Park Design for Yizhuang New City in Beijing

PROJECT STATEMENT

Agent-based models (ABMs) serve as a design medium for "bottom-up" spatial forces, exploring the essence of design. The judicious use of ABMs in auxiliary design enables a traceable approach from small-site design to large-scale planning. This project extracted large-scale spatial characteristics of the Yizhuang New City in southeastern Beijing using various urban data sources, analyzed the detailed types and distribution characteristics of urban streets, and employed agent-based models to simulate and replicate the self-organizing patterns exhibited by slime mold growth. The research and design of the central park in Yizhuang New City, conducted through ABMs, visualized the functional connections between the internal and external areas, creating a vibrant urban center where landscape ecology and functional services coexist scientifically. This approach realizes the guidance of urban cognition from a macro perspective to the design of micro-spatial experiences, providing new insights for landscape architecture from macro to micro analysis and design.

PROJECT NARRATIVE AND CONTENTS

Project Address : Yizhuang New City, Beijing, China

City&Country : Beijing, China

Project Size in SqKM : 1.01 SqKM

Research Size in SqKM : 225 SqKM

Award Category : Unbuilt Projects (Analysis & Master Planning)

1 Background

In the early years, China's singular urban development model, combined with diverse local cultures, evolved into chaotic, complex, and multifaceted public spaces. These characteristics cannot be fully described or evaluated using traditional spatial design analysis methods, thus posing unprecedented new requirements for spatial planning and design. Amid the rapid urban evolution, how can designers interpret the development mechanisms of urban public spaces shaped by the dual constructs of urbanism and humanism? Moreover, how can they acquire a "bottom-up" spatial design relationship and guide design practice?

2 Study Area

Yizhuang, an important development node in the southeastern part of Beijing, serves as the overall study area for this research. To better leverage the site's locational advantages and integrate surrounding functions, it is essential to determine the design site's position within the regional functional structure. Yizhuang New City covers a total area of approximately 225 square kilometers. The design site is located at the geometric center of the development plan for Yizhuang New City, with a total planned area of 101.04 hectares.

PROJECT NARRATIVE AND CONTENTS

3 Data Sources

The data for this study is categorized into two types: Point of Interest (POI) data and urban basic information data. The POI data was obtained through the Amap API in June 2022 and is summarized into eight types: residential, hotel accommodation, road traffic, science and education culture, healthcare, business office, commercial services, and green space sightseeing. The urban basic information data, also collected via the Amap API in June 2022, includes building vector data and road network data within the Beijing area, forming the spatial foundation for urban data analysis.

4 Experimental Design

The overall framework of this study consists of two main parts: constructing the site boundary that bears macro-level urban characteristics and building an evolutionary model for generating self-organizing textures.

The first part involves the integration and analysis of urban data to identify the types and spatial distribution of streets within the study area, with a focus on the relevant boundaries surrounding the design site.

In the second part, the analyzed boundary information of the site is imported into a slime mold growth agent-based model. By adjusting the parameters, the model simulates the formation process of the internal network paths of the site. This ultimately results in a spatial self-organizing texture incorporating the functional information of the surrounding area, providing specific guidance for path connections and functional layout within the site.

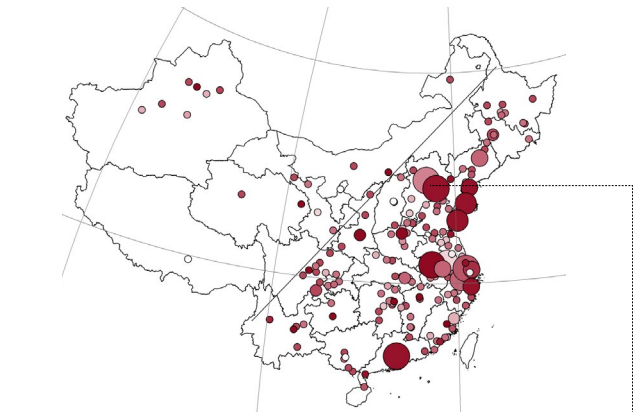
PROJECT NARRATIVE AND CONTENTS

5 Significance of the Project

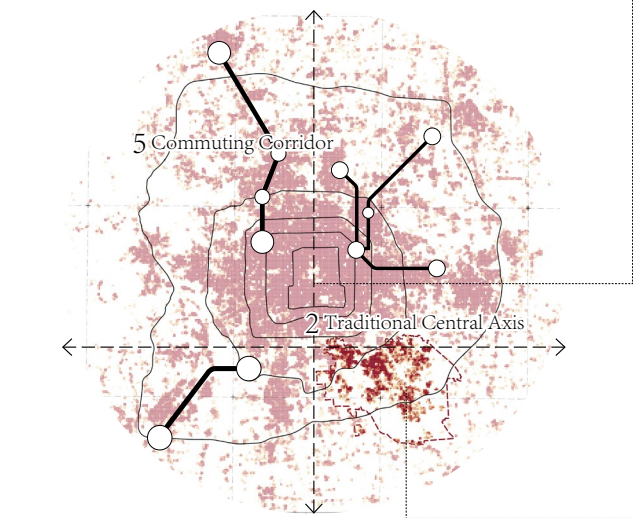
Landscape spaces, fundamentally, are sites of human activity characterized by a dynamic nature generated from the bottom up through the activities of large crowds. The design morphology simulated by agent-based models explores the operational logic between internal site functions and the external environment in a bottom-up manner, mapping spatial interactions inside and outside the site. With the aid of agent-based models, designers can simulate and analyze human behavior in various scenarios and scales. This provides an excellent simulation platform for social and natural phenomena that cannot be pre-tested in real life. By completing scenario simulations, optimized strategies for spatial design can be proposed from different perspectives. The visual representation of the model's texture presents the mechanistic connections of site functions to designers, offering more convincing algorithm-based visual predictions compared to subjectively drawn design analysis diagrams.

The digital transformation of cities has become an essential foundation and reference for the future development of urban productivity. The spatial analysis of agent-based models combined with the development of multi-source spatial data may lead to a paradigm shift in urban spatial planning. The agent-based simulation of spatial data describes spatial forms' occurrence and evolution patterns, serving as a valuable supplement to digitally augmented design.

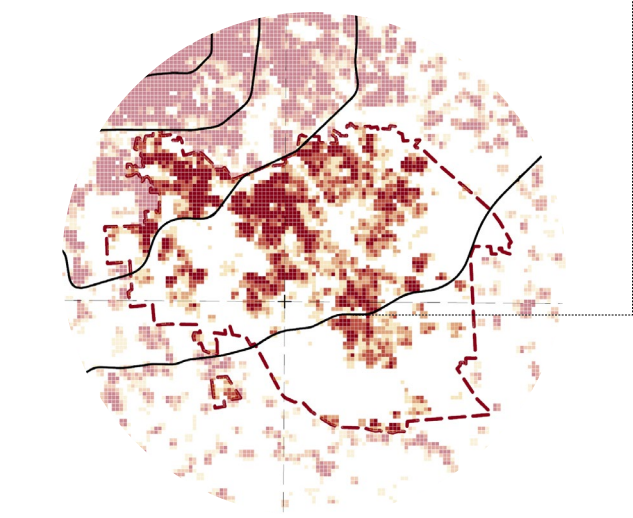
REGIONAL ANALYSIS



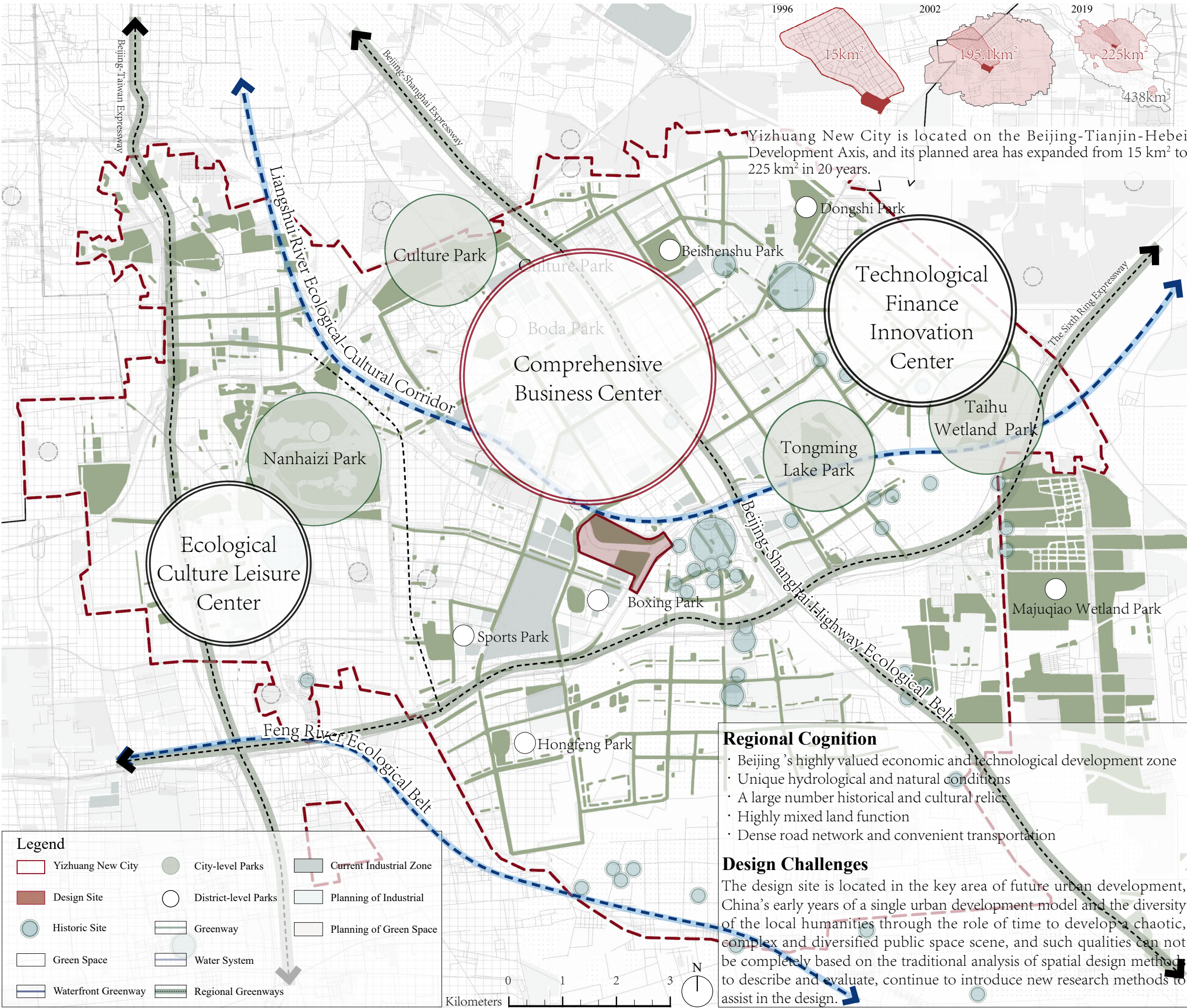
China
230 Technological Development Zones in China
Beijing Economic and Technological Development Zones has remained in the top four.



Beijing
High Interconnectivity
Urban activities are characterized by a high degree of integration and complexity.

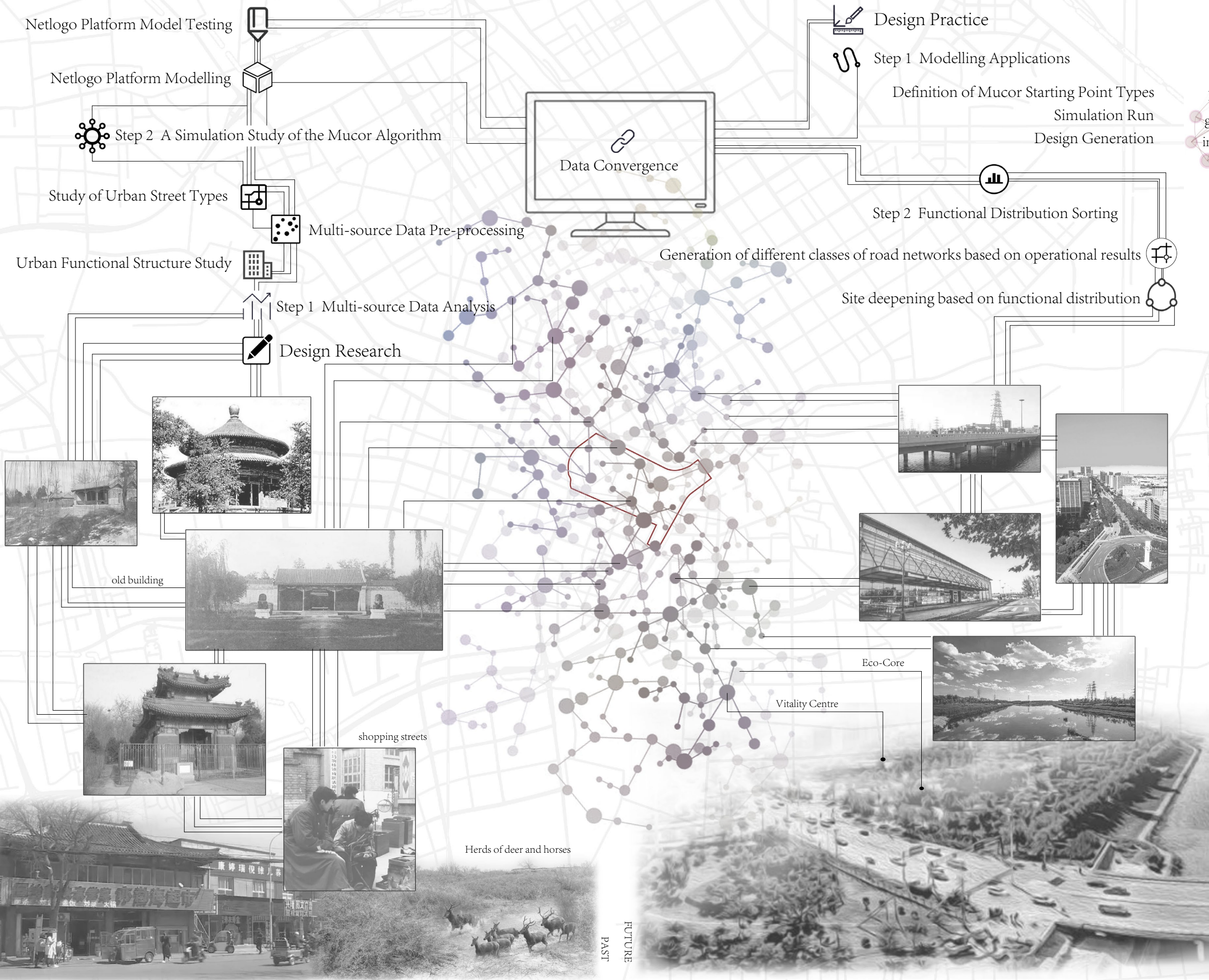


Yizhuang
Highly Mixed Urban Functions
There is a significant difference in the mixing degree of internal functions, which is manifested as the juxtaposition of farmland, villages, ancient towns, and high-density construction areas.

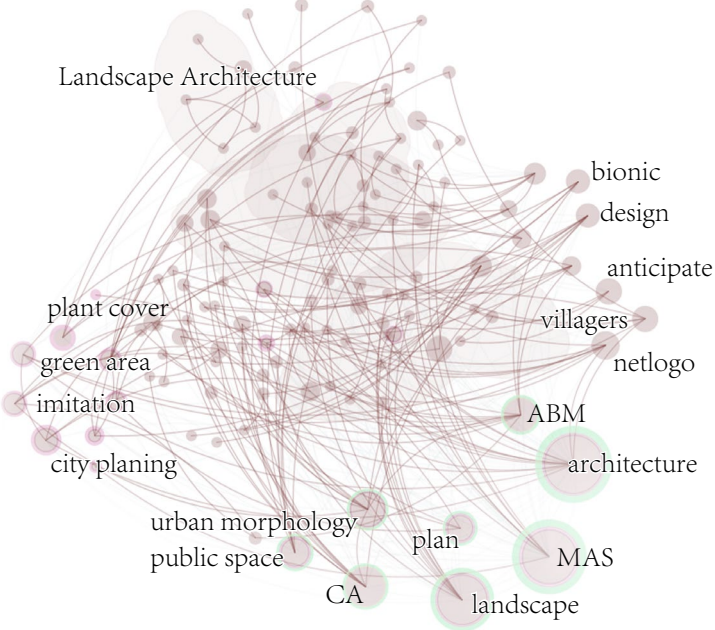


RESEARCH FRAMEWORK

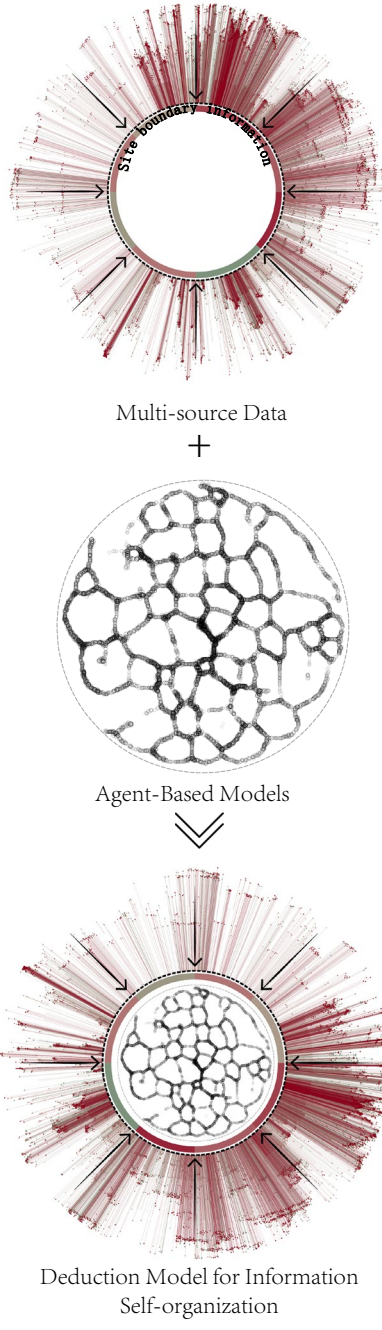
Collection of complex data on the current situation and computerized processing to derive future evolutionary trends.



LITERATURE RESEARCH KEYWORD



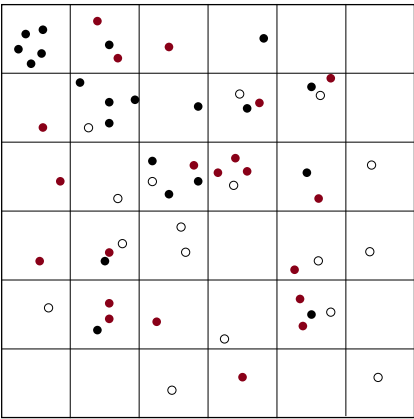
RESEARCH IDEAS



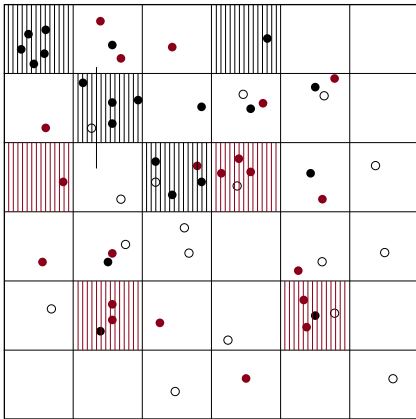
Multi-source data is a general term for different urban data with different data sources, attention perspectives and research tools. For the dynamic simulation model of urban spatial shapes, a large amount of basic information is needed to build the overall framework. With the support of multi-source data, the urban landscape spatial cognition can be constructed for the intelligent body model, so that the simulation environment is close to the real situation, and more rigorous and accurate urban landscape spatial simulation results can be obtained.

SITE POI DATA ACQUISITION AND ANALYSIS

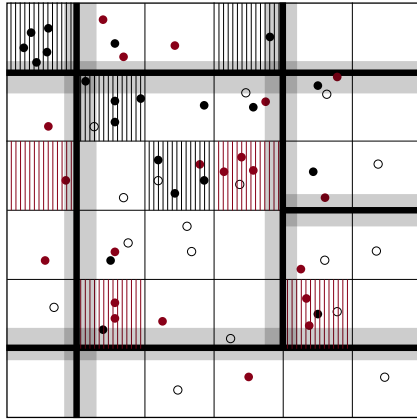
The POI Data of the site are computationally processed to obtain a functional distribution map around the site, which provides a basis for subsequent research.



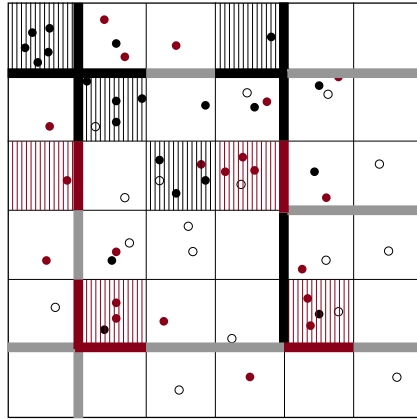
Step1 City Data Integration
POI data is used as the main data source to reflect the functional characteristics of the city, and the data categories are reclassified according to the use requirements of the public relations green space.



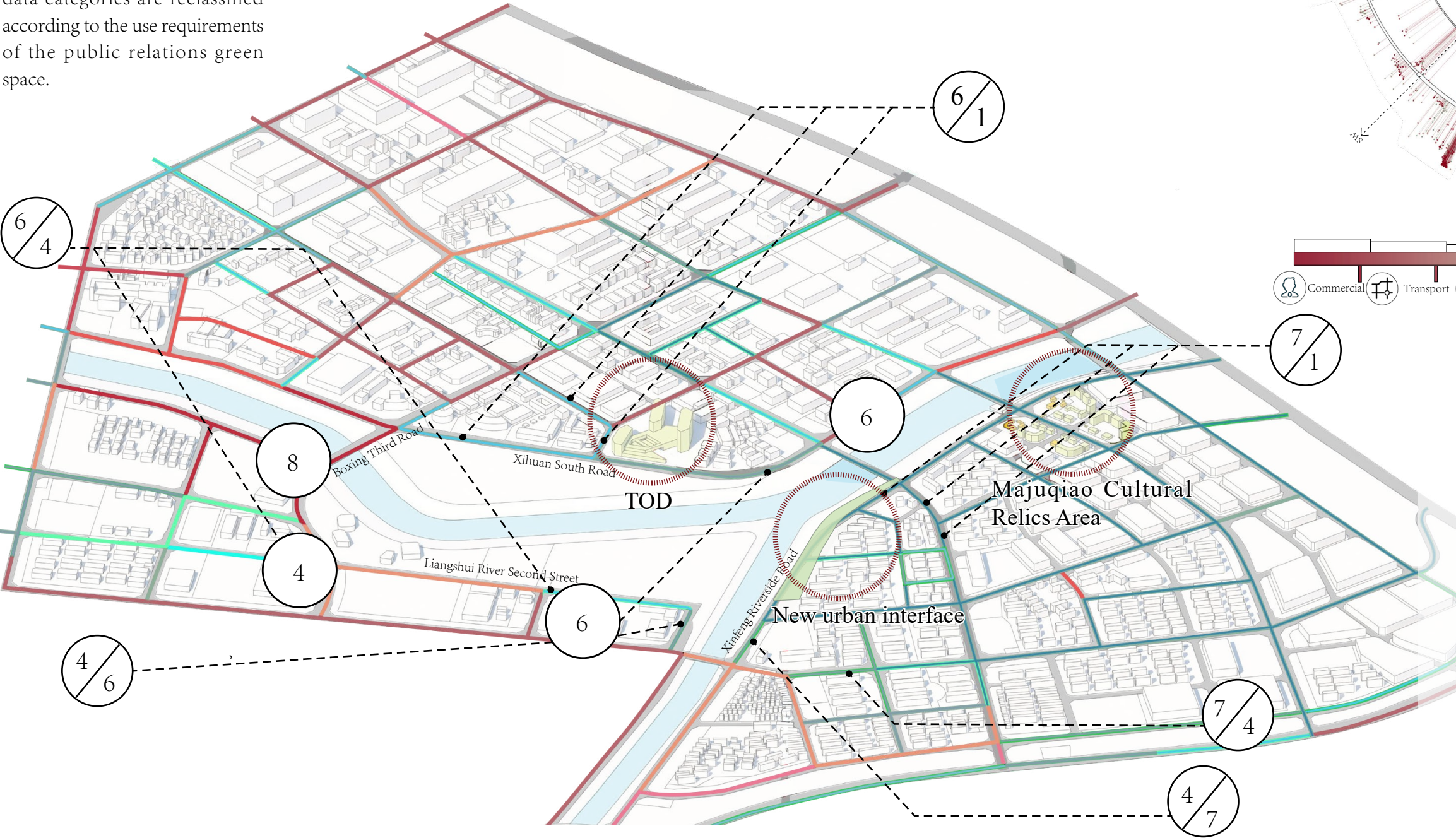
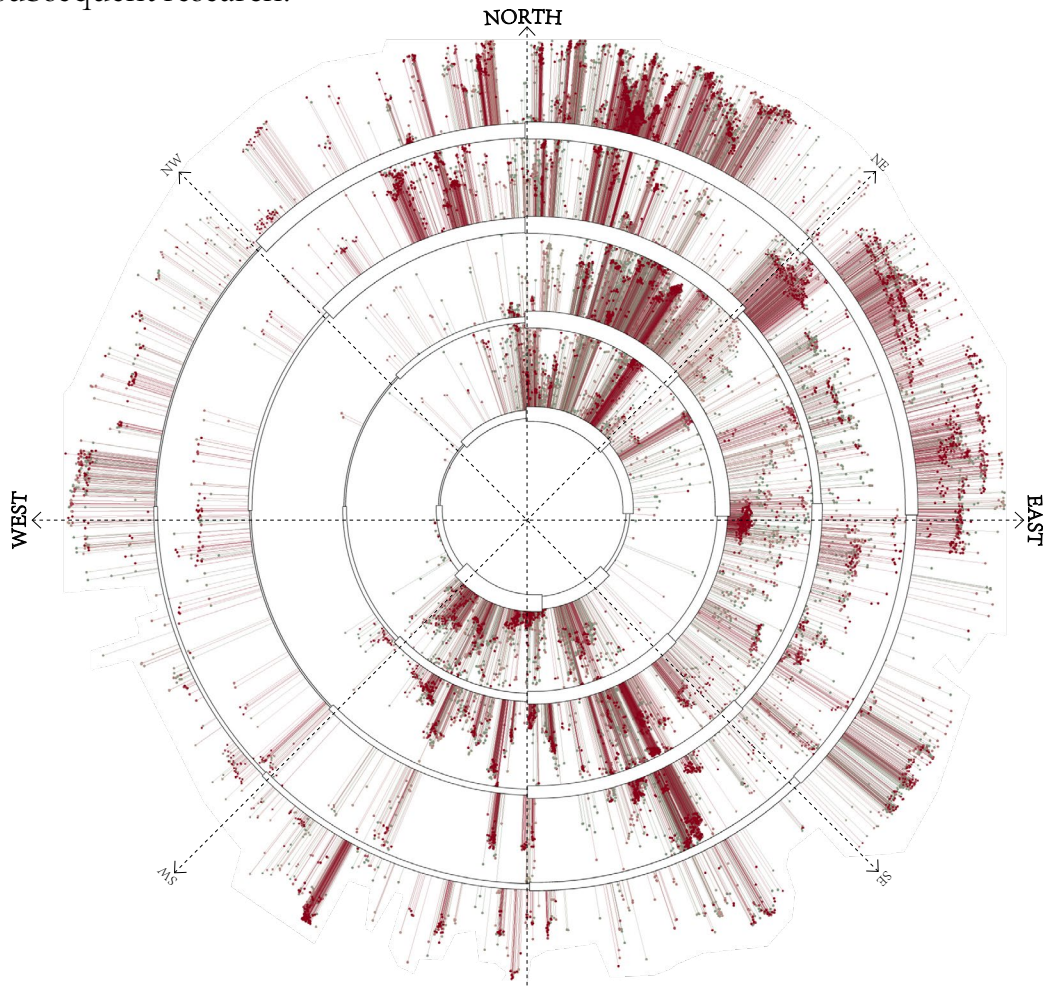
Step2 City Data Integration
FD $F_i = \frac{n_i}{N_i} (i = 1, 2, \dots, 8)$
CR $C_i = \frac{F_i}{\sum_{i=1}^8 F_i} \times 100\% (i = 1, 2, \dots, 8)$



Step3 Create Road Buffer



Step4 City Data Integration



Single Function Dominant

Id	Main Function ID	
	Function	Type Id
1	Resident	Type Id: 1
2	Hotel	Type Id: 2
3	Transport	Type Id: 3
4	Education	Type Id: 4
5	Medication	Type Id: 5
6	Work	Type Id: 6
7	Commercial	Type Id: 7
8	Tourism	Type Id: 8

Mixed Function

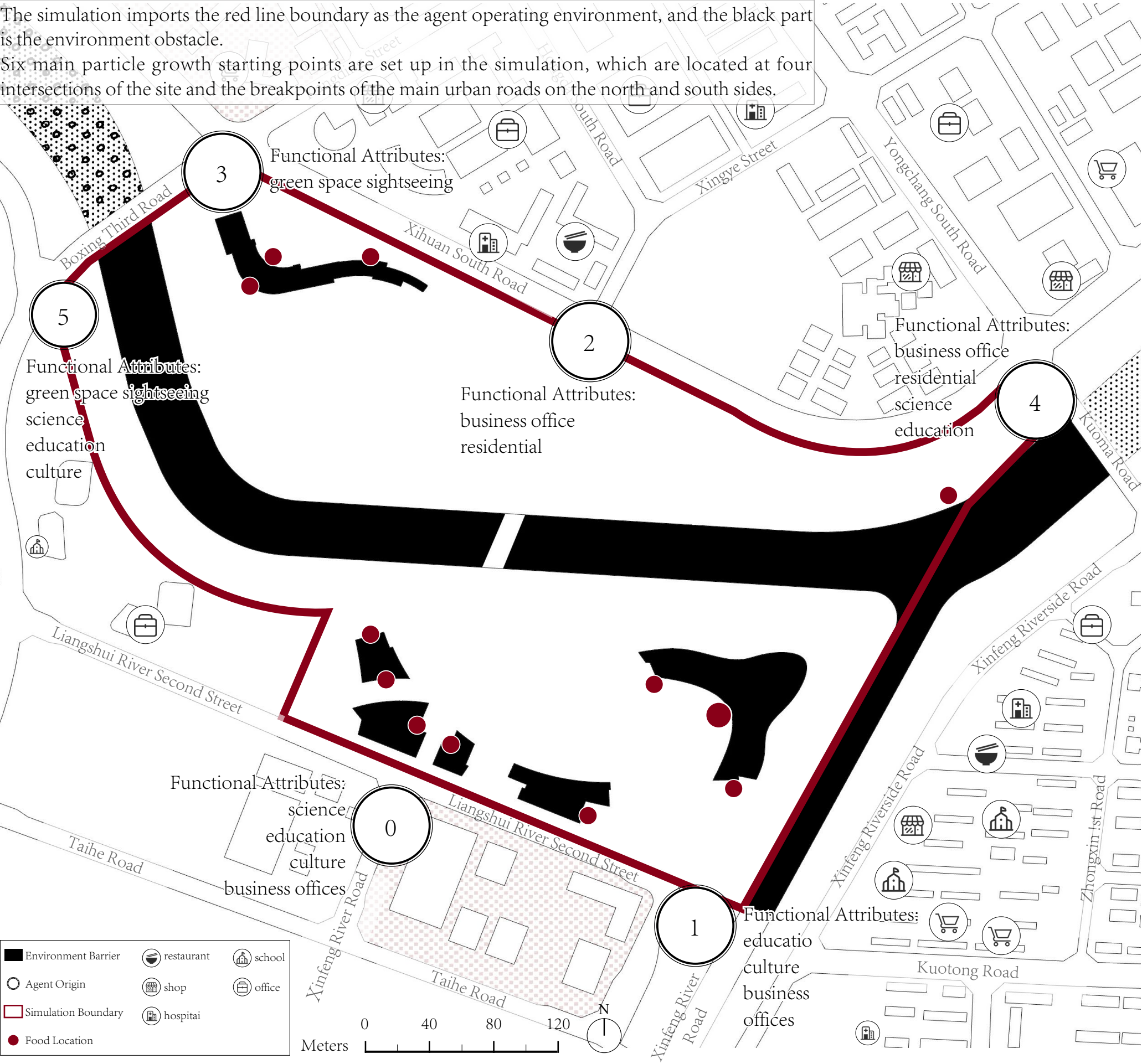
Id	Top Left-Main Function Right Bottom-Secondary	
	Function	Type Id
1	Resident	Type Id: 1
2	Hotel	Type Id: 2
3	Transport	Type Id: 3
4	Education	Type Id: 4
5	Work	Type Id: 6
6	Commercial	Type Id: 7
7	Resident	Type Id: 1
8	Transport	Type Id: 3
9	Education	Type Id: 4
10	Work	Type Id: 6
11	Commercial	Type Id: 7

CONSTRUCTION AND TESTING OF AGENT-BASED MODELS

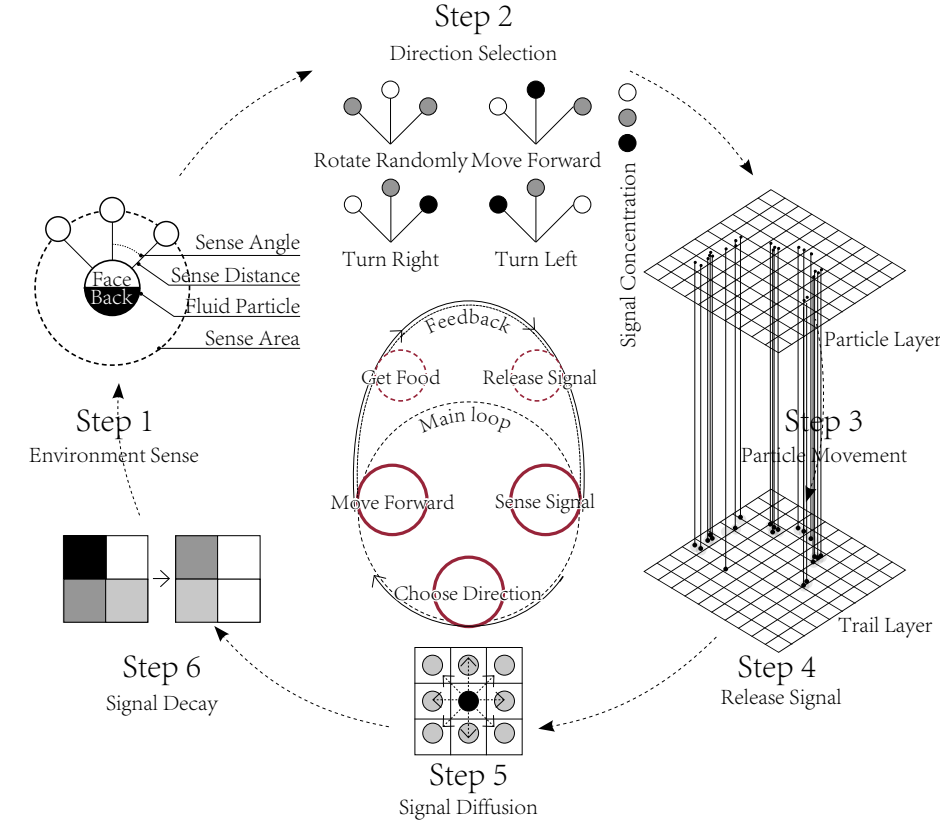
The processed site information and functional distribution maps are imported into Agent-based models for simulated shape generation.

SIMULATION ENVIRONMENT SETTINGS

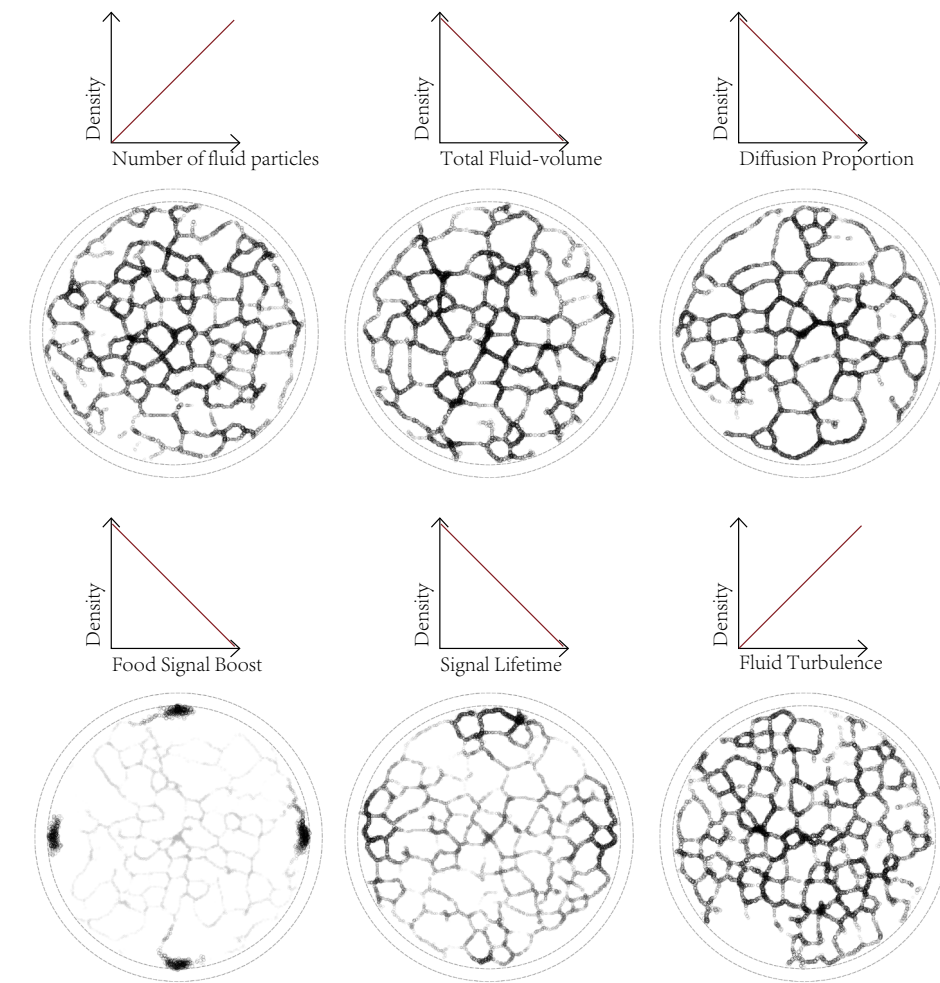
The simulation imports the red line boundary as the agent operating environment, and the black part is the environment obstacle. Six main particle growth starting points are set up in the simulation, which are located at four intersections of the site and the breakpoints of the main urban roads on the north and south sides.



AGENT-BASED MODELS OPERATING RULES



KEY PARAMETER TESTING

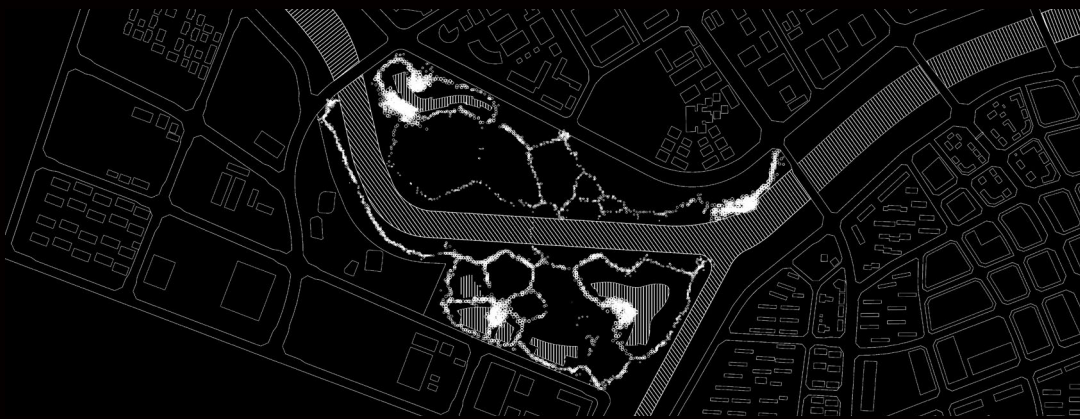


SIMULATION SCHEME DESIGN

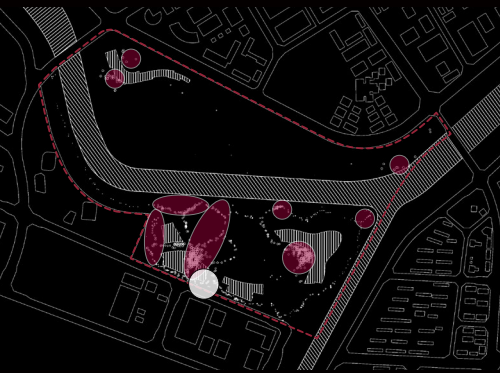
By adjusting the model parameters and iterative simulations, the most stable results of the site's raw shape were obtained, and the design sketching was started. Growth trajectories not only represent site paths, but also imply the penetration of functions.



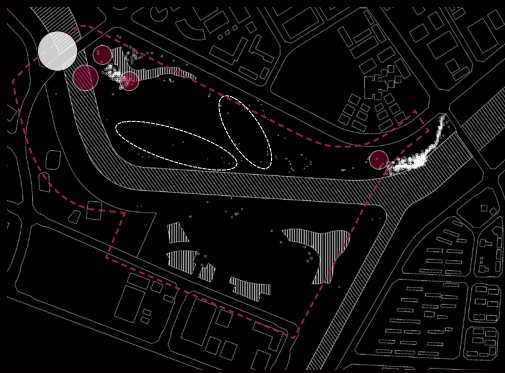
FINAL GENERATED DIAGRAM



ANALYSIS OF THE TRAJECTORY OF EACH PARTICLE



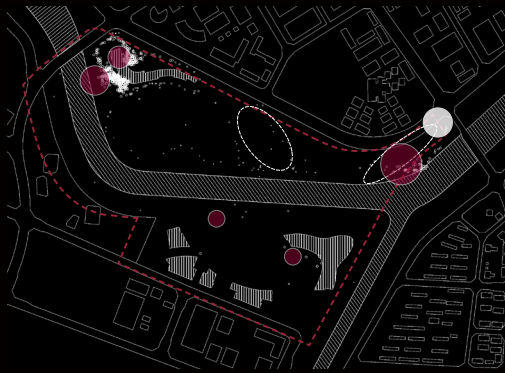
Starting point 0 :The pheromone distribution of particles



Starting point 3 :The pheromone distribution of particles



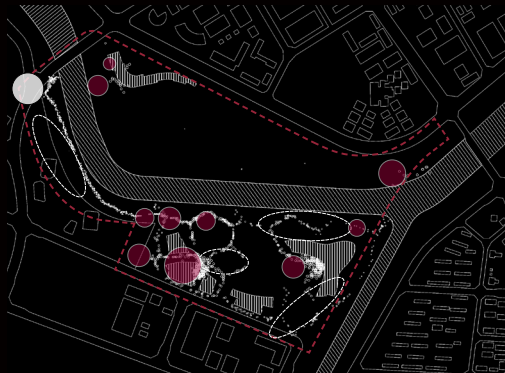
Starting point 1 :The pheromone distribution of particles



Starting point 4 :The pheromone distribution of particles



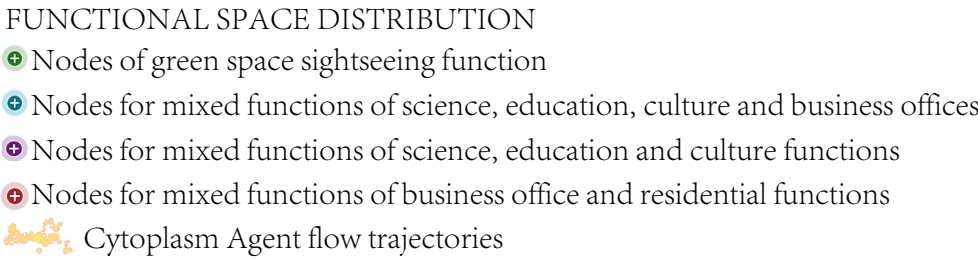
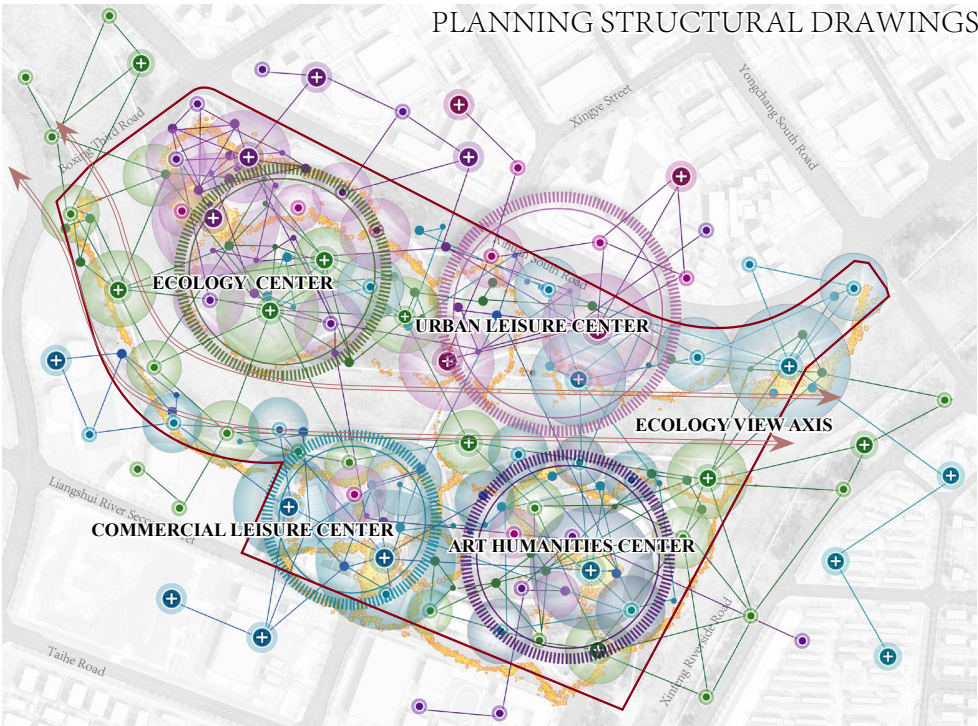
Starting point 2 :The pheromone distribution of particles



Starting point 5 :The pheromone distribution of particles

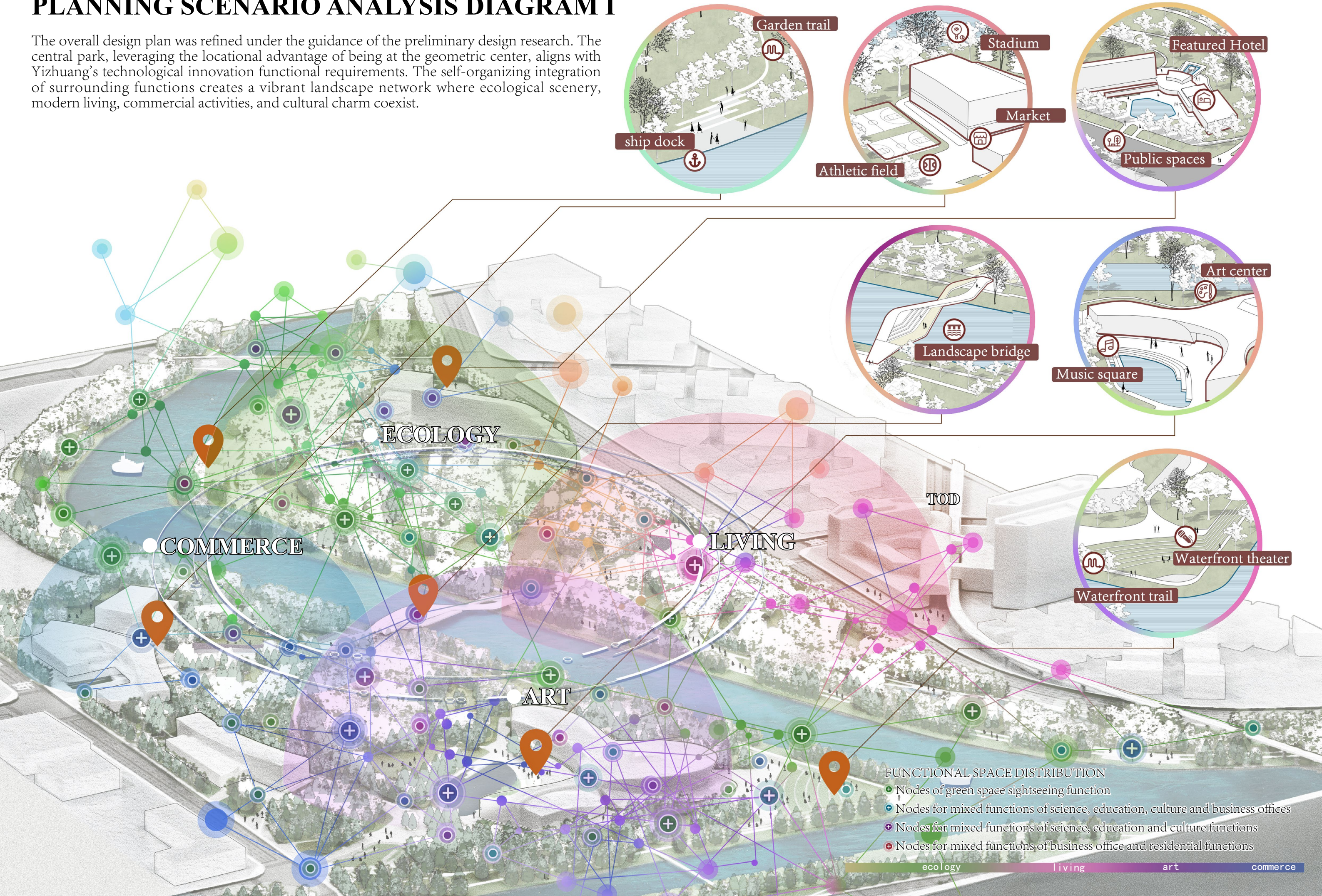
MASTER PLAN

By analyzing the paths of six intelligences with different functional attributes, the most suitable site functional distribution map can be obtained for the design site under the influence of external functional areas, which provides guidance for the later detailed design.



PLANNING SCENARIO ANALYSIS DIAGRAM I

The overall design plan was refined under the guidance of the preliminary design research. The central park, leveraging the locational advantage of being at the geometric center, aligns with Yizhuang's technological innovation functional requirements. The self-organizing integration of surrounding functions creates a vibrant landscape network where ecological scenery, modern living, commercial activities, and cultural charm coexist.



PLANNING SCENARIO ANALYSIS DIAGRAM II

The entire central park comprises an art center, museum, gallery, commercial districts, and more, establishing a multifaceted multifunctional space. The flow of people constructs a multi-dimensional spatial functional network, with green public spaces serving as the implementation carriers of these spatial functions. This creates a complex urban public space system that integrates into the city's functional framework.



PLANNING SCENARIO ANALYSIS DIAGRAM III

The establishment of urban landscape bridges along both sides of the city's rivers has created a cohesive flow of functions, forming an efficient urban connection system between the northern and southern banks. The construction of these bridges has activated the functions of various sites, while the TOD urban complexes effectively provide a diverse composition of people for these sites. On one hand, the spatial structure generation analysis of the agent-based model establishes bridge connections, and on the other hand, it completes the spatial scenario design concept for Yizhuang Future City.

