

Data Augmented Design

and Its Application for Creating Future Cities

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CONTENT

- Section 1 DAD Introduction
- Section 2 The Springer DAD Book
- Section 3 DAD Application for Creating Future Cities



1

DAD INTRODUCTION

1 DAD Introduction

Definition



数据增强设计*

——新数据环境下的规划设计回应与改变

Data Augmented Design: Urban Planning and Design in the New Data Environment

龙瀛 沈尧

文章编号1673-8985 (2015) 02-0081-07 中图分类号TU981 文献标识码A, B

Empowered by emerging big and open urban data, together with quantitative spatial analysis and statistical approaches and cutting edge techniques like artificial intelligence, DAD provides a supporting platform for the whole planning and design process, ranging from field investigation, existing condition analysis, future forecasting, scheme design, operation evaluation, and feedback. It is hoped that the application of DAD in planning and design practice could improve the scientific level of planning and design and inspire planners and designers (Long and Shen, 2015).

DAD belongs to a new planning and design support form after CAD (Computer-Aided Design), DSS (Decision Support System), GIS (Geographical Information System), and PSS (Planning Support System). (CAD->GIS->DSS->PSS->DAD)

1 DAD Introduction



Comparison of DAD to other planning and design support formats

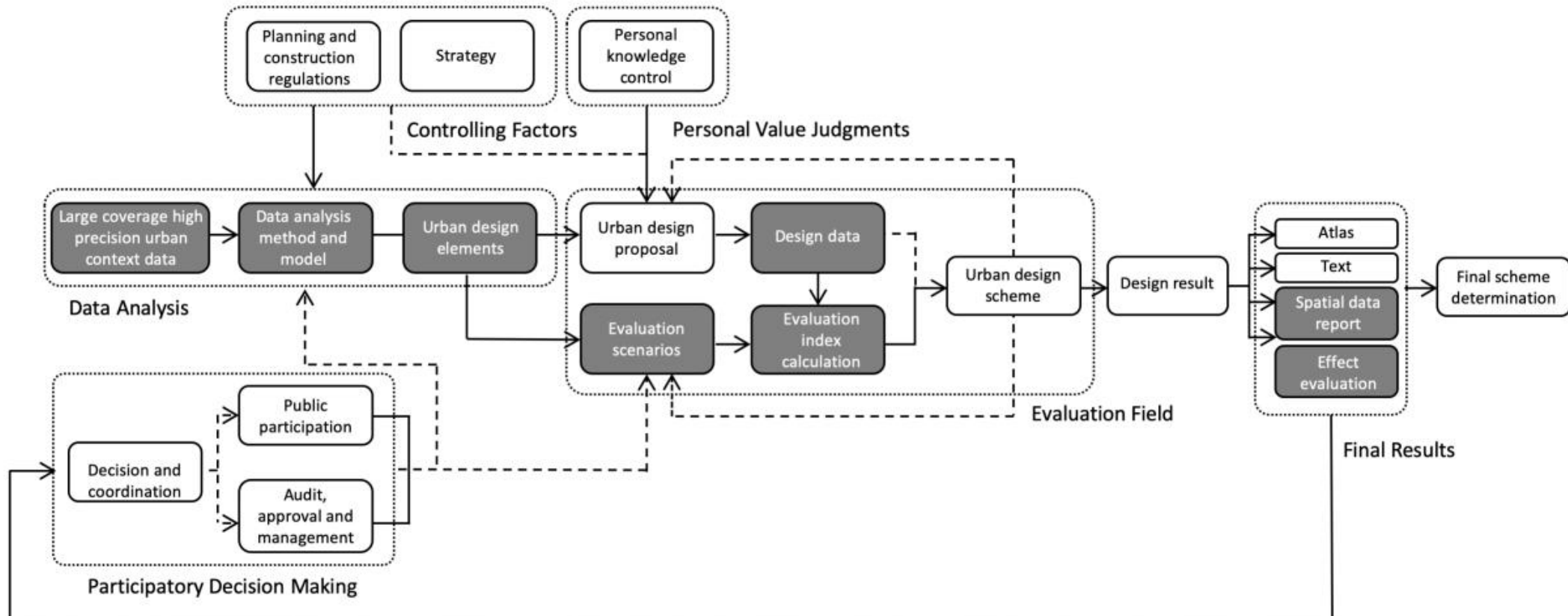
Concepts	Core Function	Period	Driving force	Process	Scale
ES (Expert System)	A process based on knowledge and expert experience for finding solutions to problems	Long-term	Experience-and knowledge-driven	Classification, diagnosis, monitoring, design, scheduling, and planning for specialized endeavors	Whole scale
CAD (Computer-Aided Design)	Planning and design support software tools	Short-term	Data-driven	Design generation	Whole scale
GIS (Geographic Information System)	Planning and design support software tools	Short-term	Data-driven	Existing condition analysis, design generation, and visualization	Whole scale
DSS (Decision Support System)	A collection of tools for the decision-making process	Short-term	Model-driven	Decision making	Macroscale
SDSS (Spatial Decision Support System)	A collection of tools for the spatial decision-making process	Short-term	Model-driven	Decision making	Macroscale
PSS (Planning Support System)	A collection of tools and a framework for the planning process	Long-term	Model-driven	The whole process of planning	Macroscale
DAD (Data Augmented Design)	A collection of tools and a framework for the planning and design process	Long-term	Data-driven	The whole process of planning and design	Mesoscale and microscale

1 DAD Introduction



Process of DAD

- Inspire the extraction of design elements and the generation of concepts;
- Augment the optimisation of planning and design;
- Support the output expressions of planning and design;
- Help to reduce communication costs;
- Lead to a more transparent urban management atmosphere



The specific planning and design support format of DAD (Long and Shen 2015)

1 DAD Introduction

Research network and annual conferences



The DAD research network was established in 2015 as a community for DAD and led principally by a Tsinghua University team.

- In April 2016, Tsinghua University Henglong Real Estate Research Center established a **DAD research lab**.
- In December 2016, the Chinese Society For Urban Studies established **Technical Committee for Urban Big Data**.

The DAD symposium, as an **annual conference** for the DAD research network was launched to facilitate the dissemination of up-to-date DAD research and applications from members of the research network.

- Beijing Jiaotong University (2015)
- Tsinghua University (2016)
- Southeast University (2017)
- Tsinghua University (2018)
- China Architecture Design & Research Group (2019)
- Tongji University (2020)



Posters of annual conferences

1 DAD Introduction

Education-School of Architecture, Tsinghua



清华大学建筑学院
School of Architecture, Tsinghua University

*Big Data and Urban Planning,
Structural Urban Design,
Urban and Rural Comprehensive Survey,
Introduction to Urban Modelling,
The New Science of Cities.*

1. Theoretical courses expand students' visions and promote the acceptance of new data and cutting-edge technologies
2. Practical courses encourage students to apply the DAD framework and philosophy in design studios and workshops



1 DAD Introduction

DAD in urban planning and design practice



Urban planning and design project

- Urban design of Xiong'an New Area
- Urban design of Tongzhou Sub-center

Urban planning and design competition

- 2016/2017/2018 Shanghai Urban Design Challenge
- Yilong Futuristic City International Design Competition
- Big Data Supported Space Planning and Design Competition
- Urban Planning and Design Workshop for Shrinking Cities

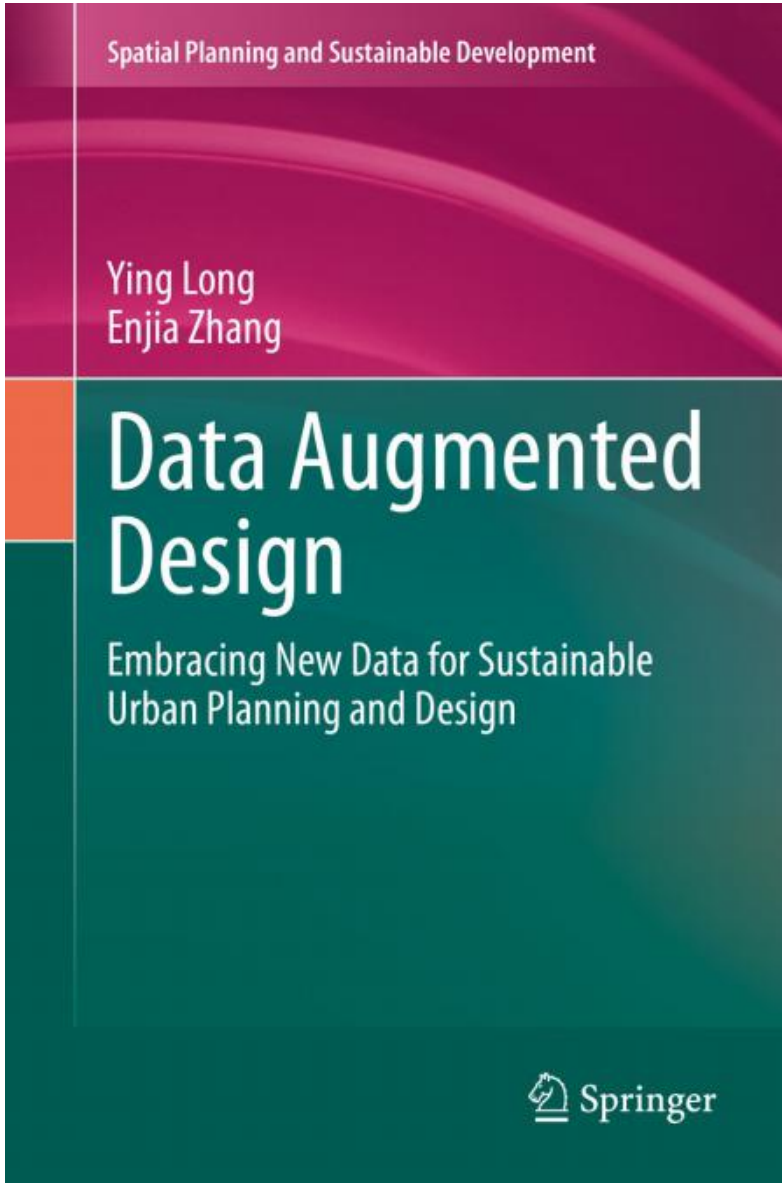


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2

THE SPRINGER DAD BOOK

2 The Springer DAD Book



1

Part I Overview

Chapter 1-3

2

Part II Understanding the Elements of a Site to Better Design Sites

Chapter 4-6

3

Part III Learning from Other Cases to Better Design Sites

Chapter 7-8

4

Part IV Embracing Advanced Technologies and Transitioning of Cities into Better Designed Sites

Chapter 9-10

5

Appendix

Appendix 1-3

Part I Overview

Chapter 1 Cities in Transition



Artificial Intelligence

Big data and
cloud computing



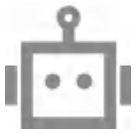
Mobile
Internet(4/5G)

Sensor network and
Internet of Things



Mixed
Reality(VR/AR/MR)

Intelligent
construction



Robots and
automation system

Blockchain



WeSpace

Future Cities from the Lens of Space



For more information (Chinese and English Version):

<https://www.beijingcitylab.com/projects-1/48-wespace-future-city-space/>

Chapter 1

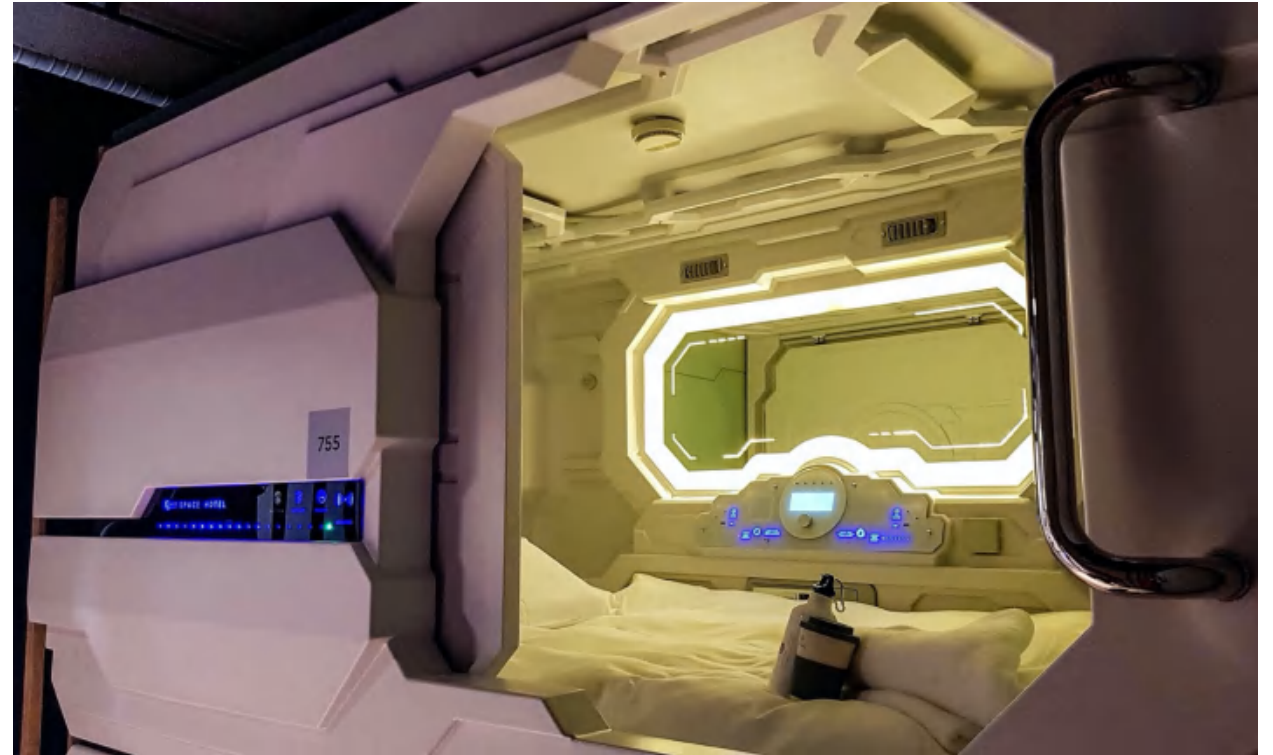
Cities in Transition

■ Residence: **Functional transformation and reconstruction**

- Spatial fragmentation: **The living space shows fragmentation development and more small living spaces meeting the instant needs have appeared.**



• Prefabricated container residence



• Capsule Hotel

Chapter 1

Cities in Transition

■ Employment: Functional transformation and reconstruction

- **Space fragmentation: The further fragmented office space can make up the shortcomings of traditional single-function/scale land development model.**
- **The commercialization and specialization of the third space: The forms designed for office workers such as office coffee shops, study rooms, libraries, shared office spaces, etc. are more abundant.**



- A shared small office cabin charged by minute. People can quickly find an office space on a business trip/journey and carry out temporary work quietly and comfortably.



- The soundproof booths in the office can meet the needs of remote working and conference discussion, etc.



- SMART LOUNGE is divided into different forms of working areas

Chapter 1

Cities in Transition

■ Transportation: Location change and structure

- Three-dimensional and underground transportation: The logistics and fast lanes have been moved to underground, further using the underground space and urban gray space.

Underground unmanned driving transportation and parking



- Boring underground driverless tunnel and public transportation system

Underground logistics



- Underground logistics system in Xiong'an

Underground garbage transportation

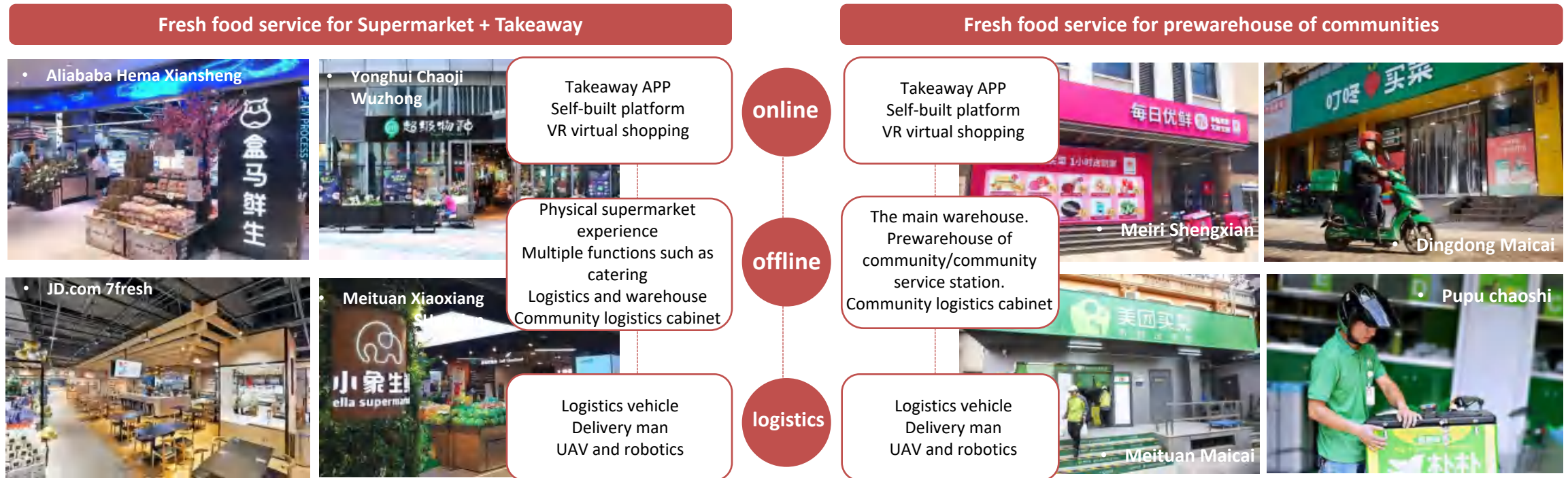


- The vacuum garbage collection system is constructed in Jiangbei New District, Nanjing.

Chapter 1 Cities in Transition

■ Recreation-shopping: **Functional transformation and reconstruction**

- **OMO (Online-Merge-Offline):** Provides convenient living services based on location, and is equipped with personalized logistics, delivery and warehouses centering on communities.

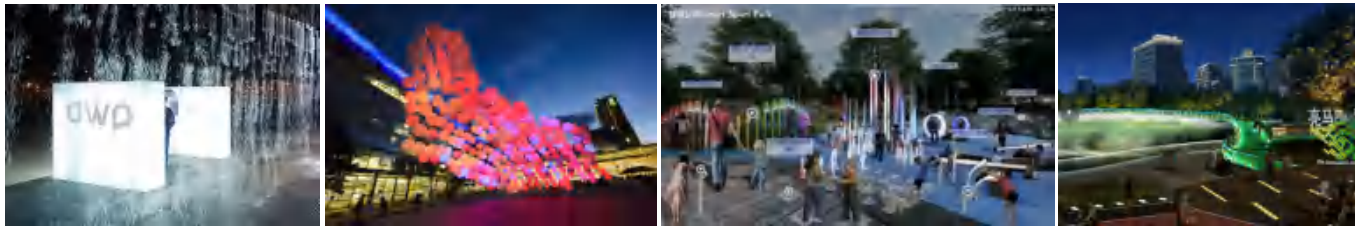


Chapter 1 Cities in Transition

■ Recreation-entertainment: **Functional transformation and reconstruction**

- **Space experience: The superposition of digital facilities enables public space to provide people with personalized interactive experience and enhance the attractiveness of public space. In the future, offline space + interactive facilities, "offline space + live stream", "offline space + AR/VR" models will become the development tendencies of public space.**

Offline space + digitalized interactive facilities



Digital waterside pavilion
/Carlo Ratti Associati

Interactive
bubbles/UNSENSE

Interactive facilities/
DreamDeck

The interaction of light-
water interaction
/DreamDeck



Immersive, interactive display facility
/ MIT SENSEable City Lab

Gravity fountain design / DreamDeck

Interactive projection facilities/
DreamDeck

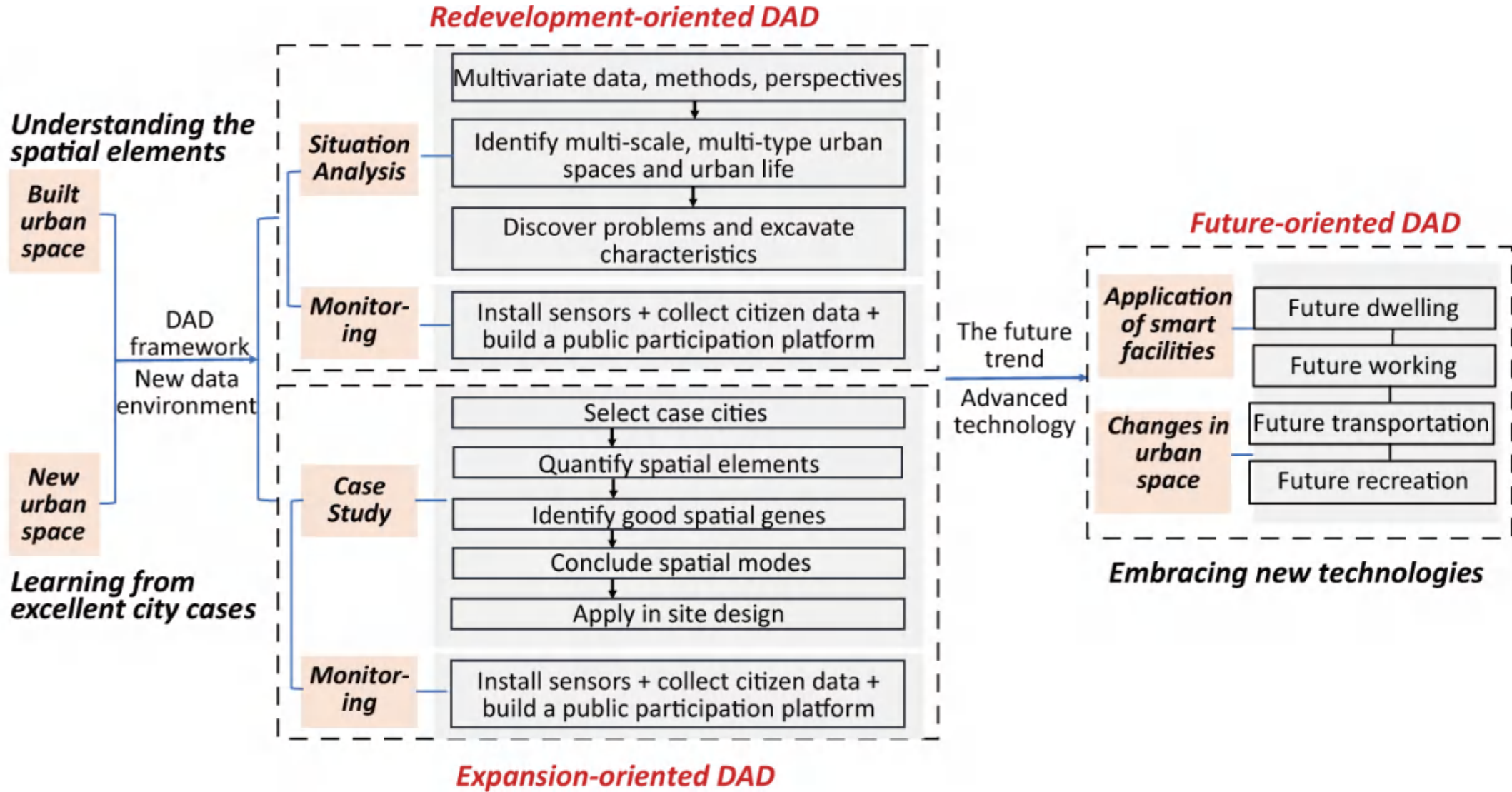
- TOP100 designs of public space of architecture firms are integrated more interactive experience facilities.

Offline space +AR/VR/live stream



- Columbia "AR"Virtualness and Reality integrated public recreation space

Data Augmented Design (DAD): Definitions, Dimensions, Performance, and Applications

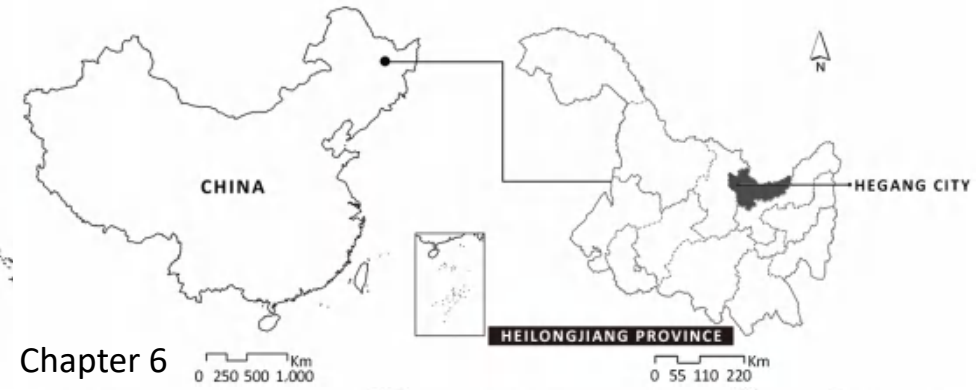
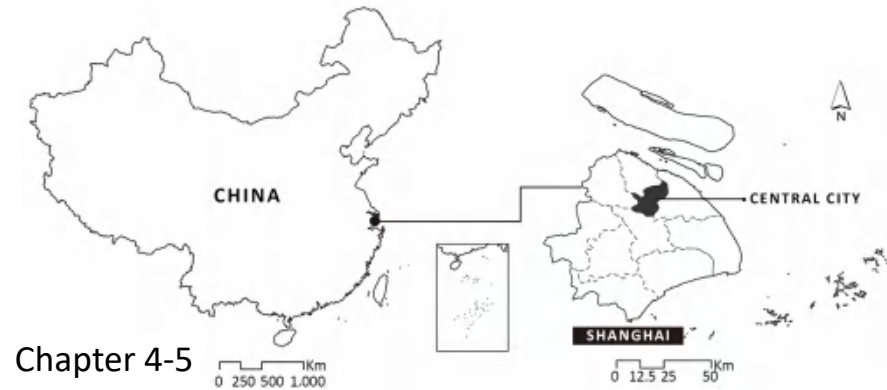


Three typical applications of DAD for different design types

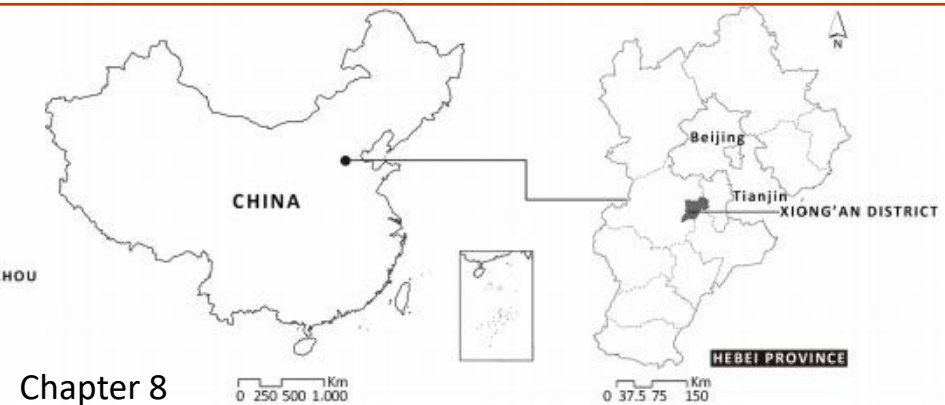
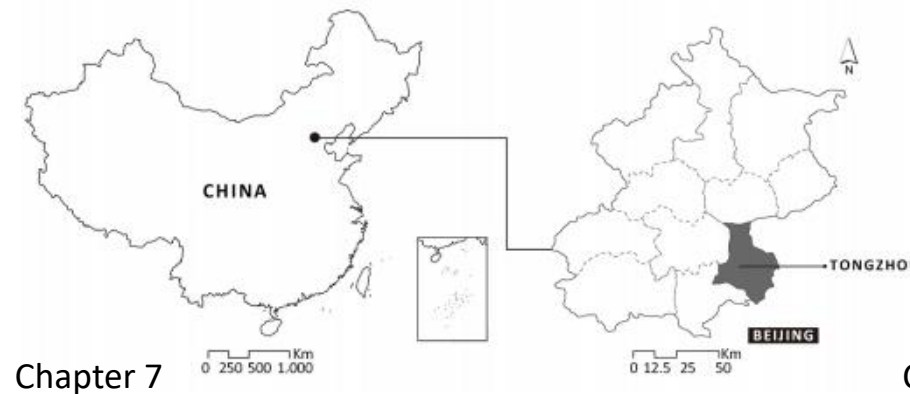
Chapter 2

Data Augmented Design (DAD): Definitions, Dimensions, Performance, and Applications

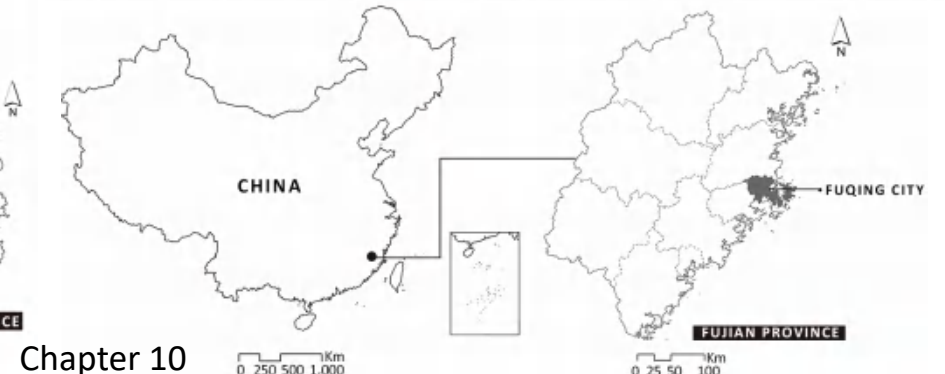
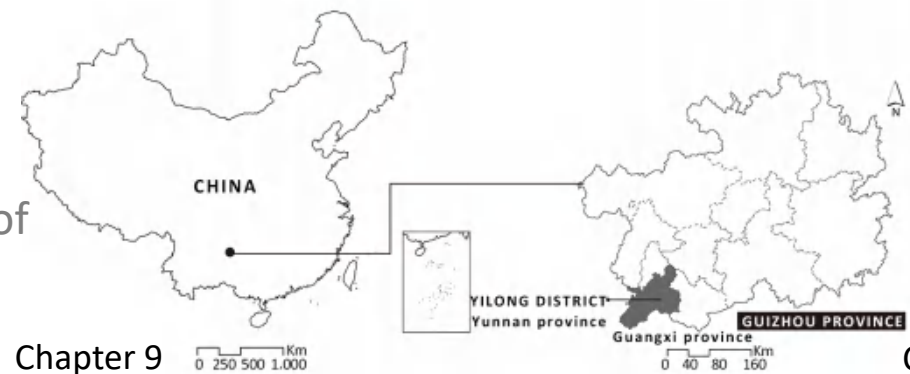
1. DAD for redevelopment-oriented planning and design: Understanding the Elements of a Site to Better Design Sites



2. DAD for expansion-oriented planning and design: Learning from Other Cases to Better Design Sites



3. DAD for future cities: Embracing Advanced Technologies and Transitioning of Cities into Better Designed Sites

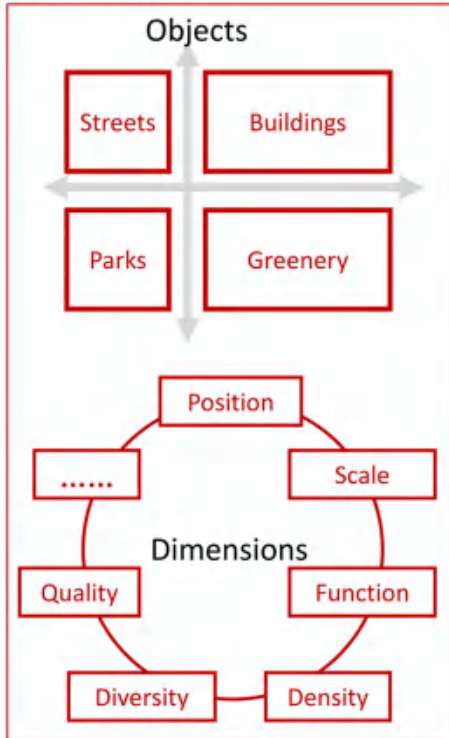


Chapter 3

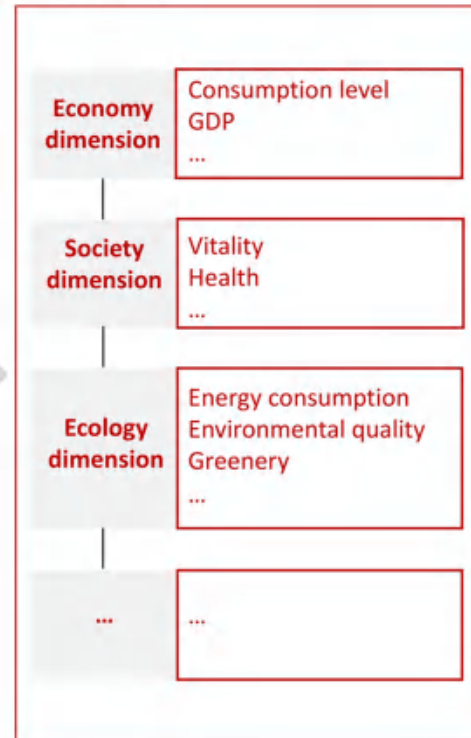
Human-scale Urban Form and Its Application in DAD

Human-scale urban form is closely related to human attributes, which can be seen and felt by human beings. Streets, buildings, and attributes of the surrounding physical environment are the components of human-scale urban form.

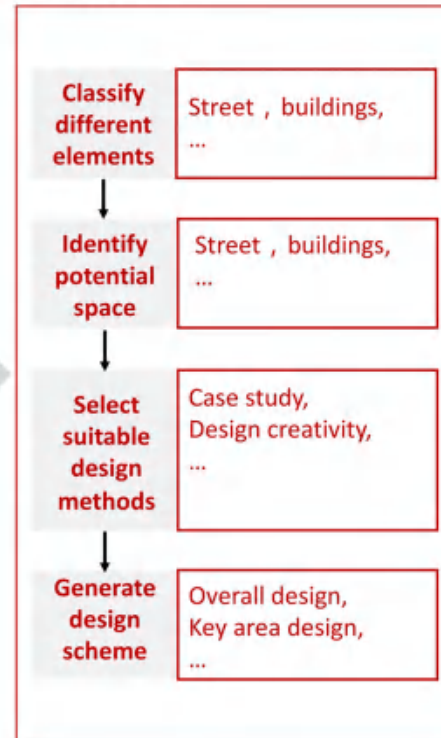
Urban Form Measurement



Performance Evaluation



Urban design Intervention



The framework of human-scale urban form



Special Issue in *Landscape and Urban Planning*
(Long and Ye 2019)

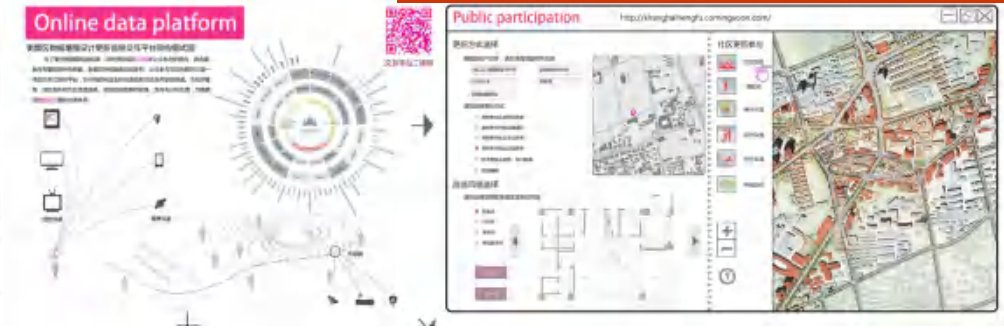
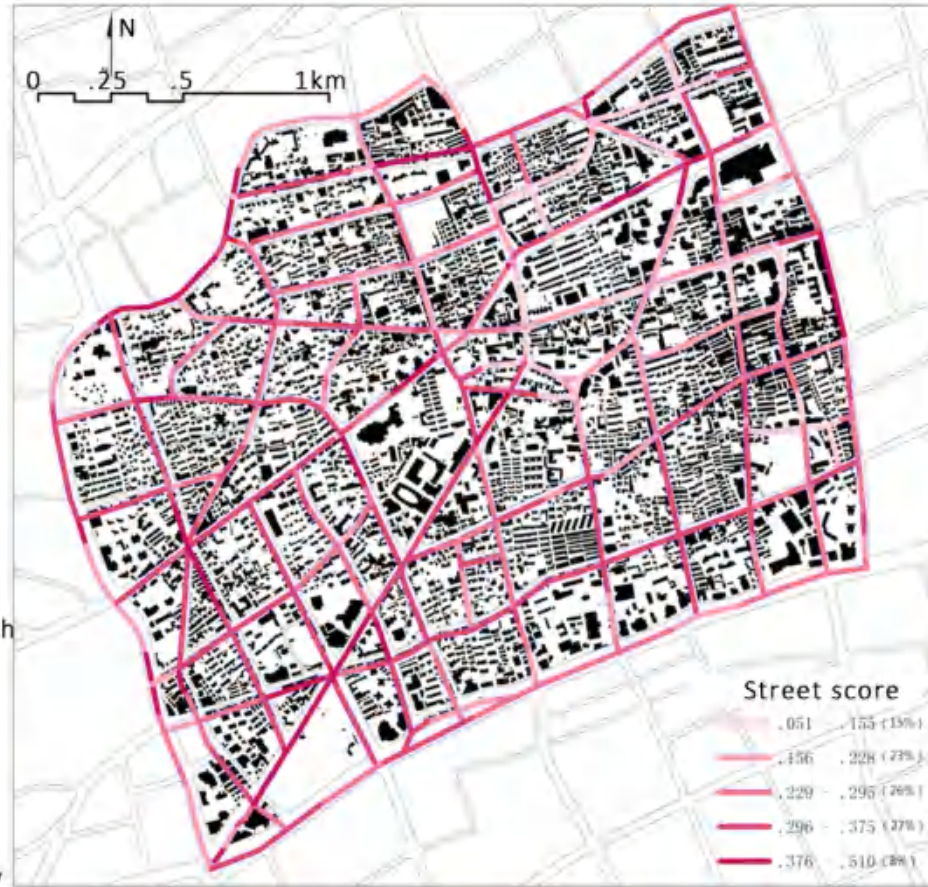
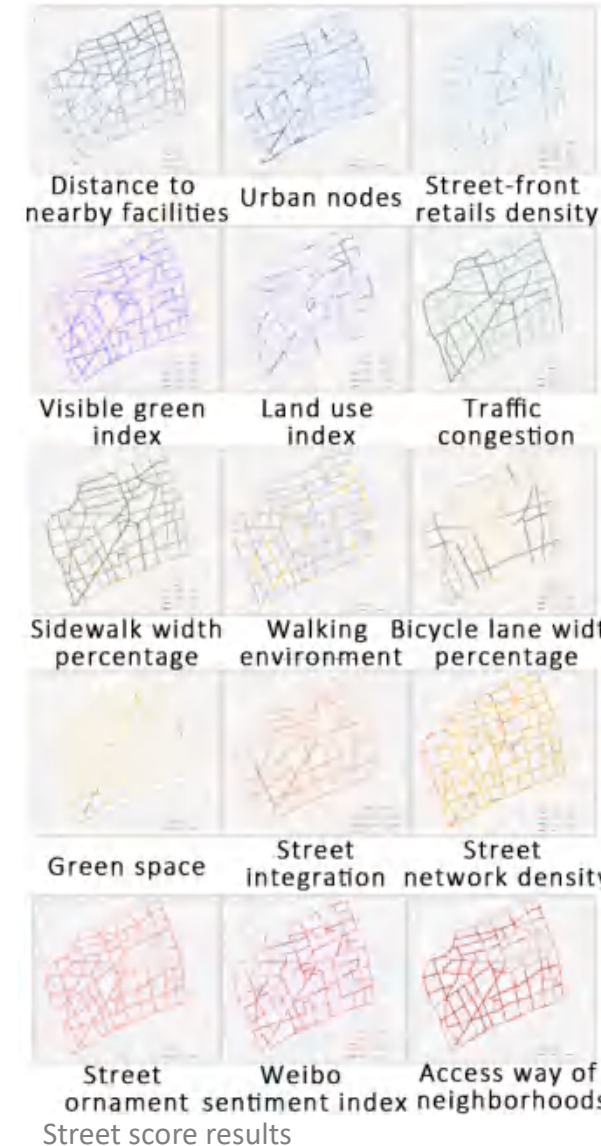


Chapter 4

Data Adaptive Urban Design: A Case Study of Shanghai Hengfu Historical District

Historical district

Adaptive urban design



Interaction website for information sharing and public participation

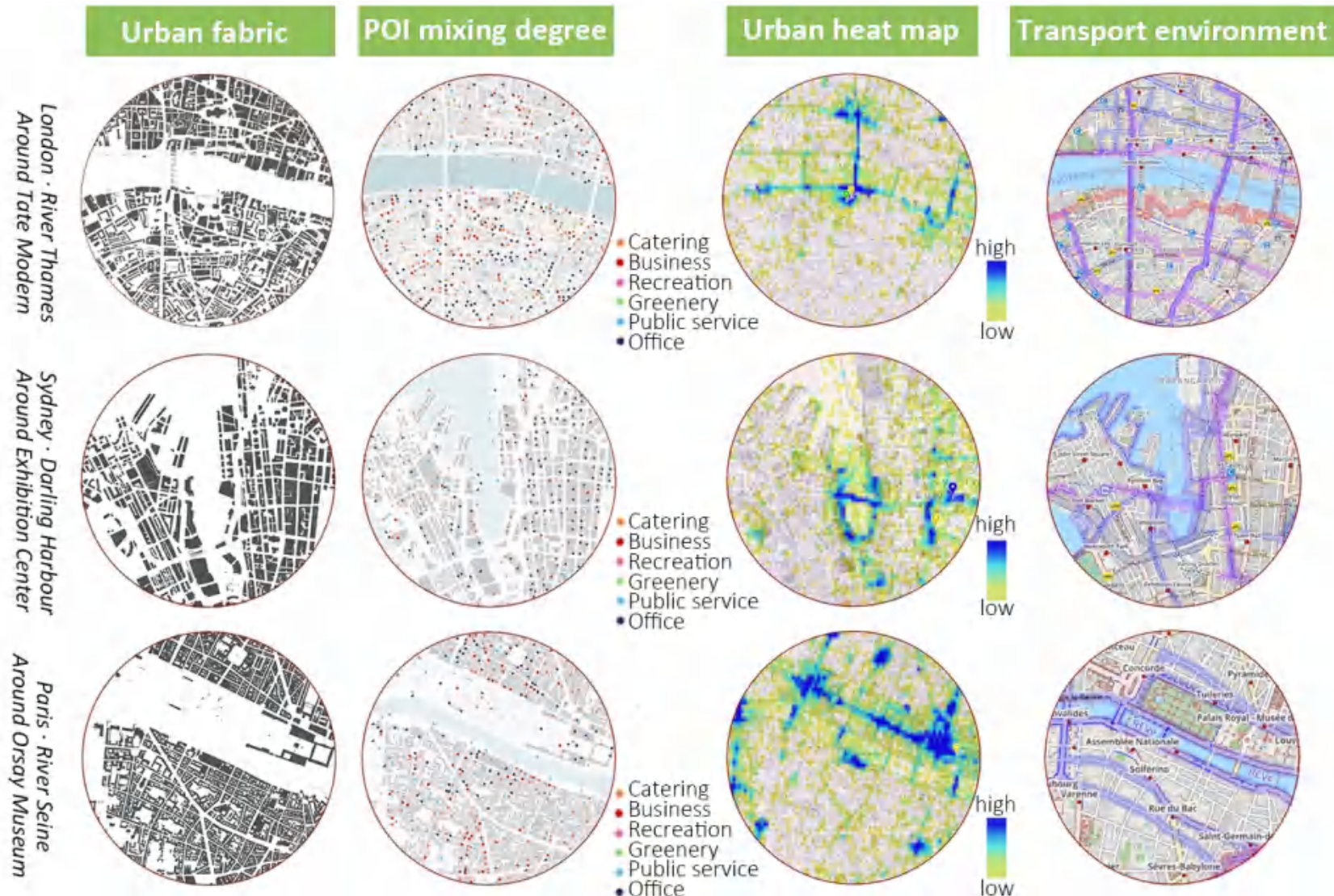


Bird's eye view of type A streets



Chapter 5

Multidimensional Data-Based City Images: Cultural Reactivation of Waterfront Industrial Heritage Design in Shanghai



Industrial heritage design
City image



International case comparison: world-class art culture waterfront space

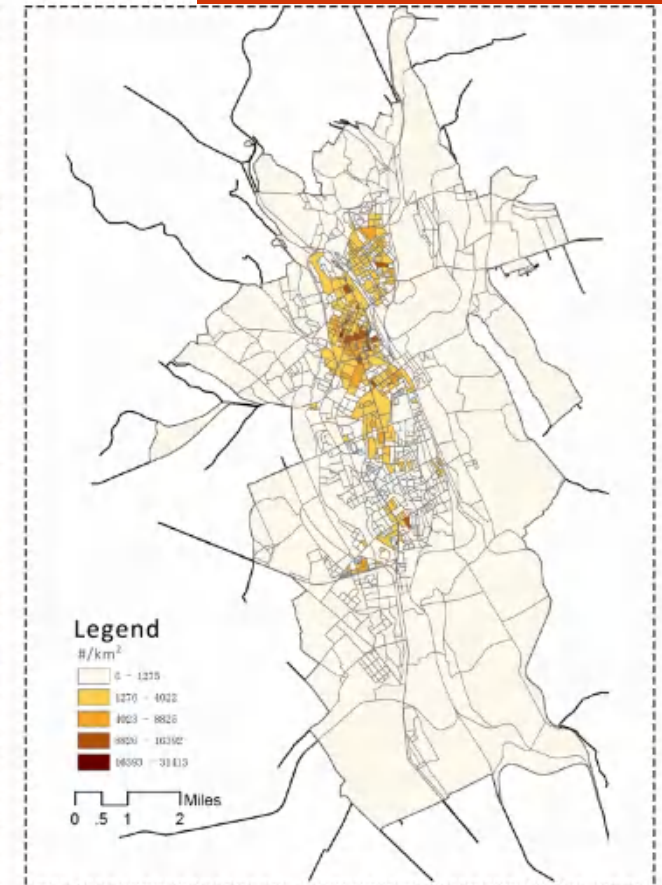
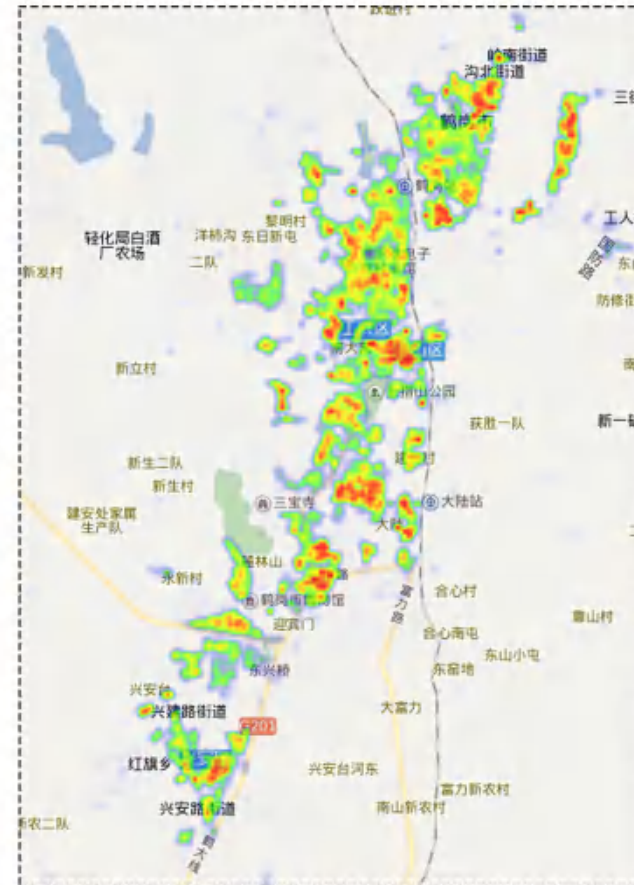
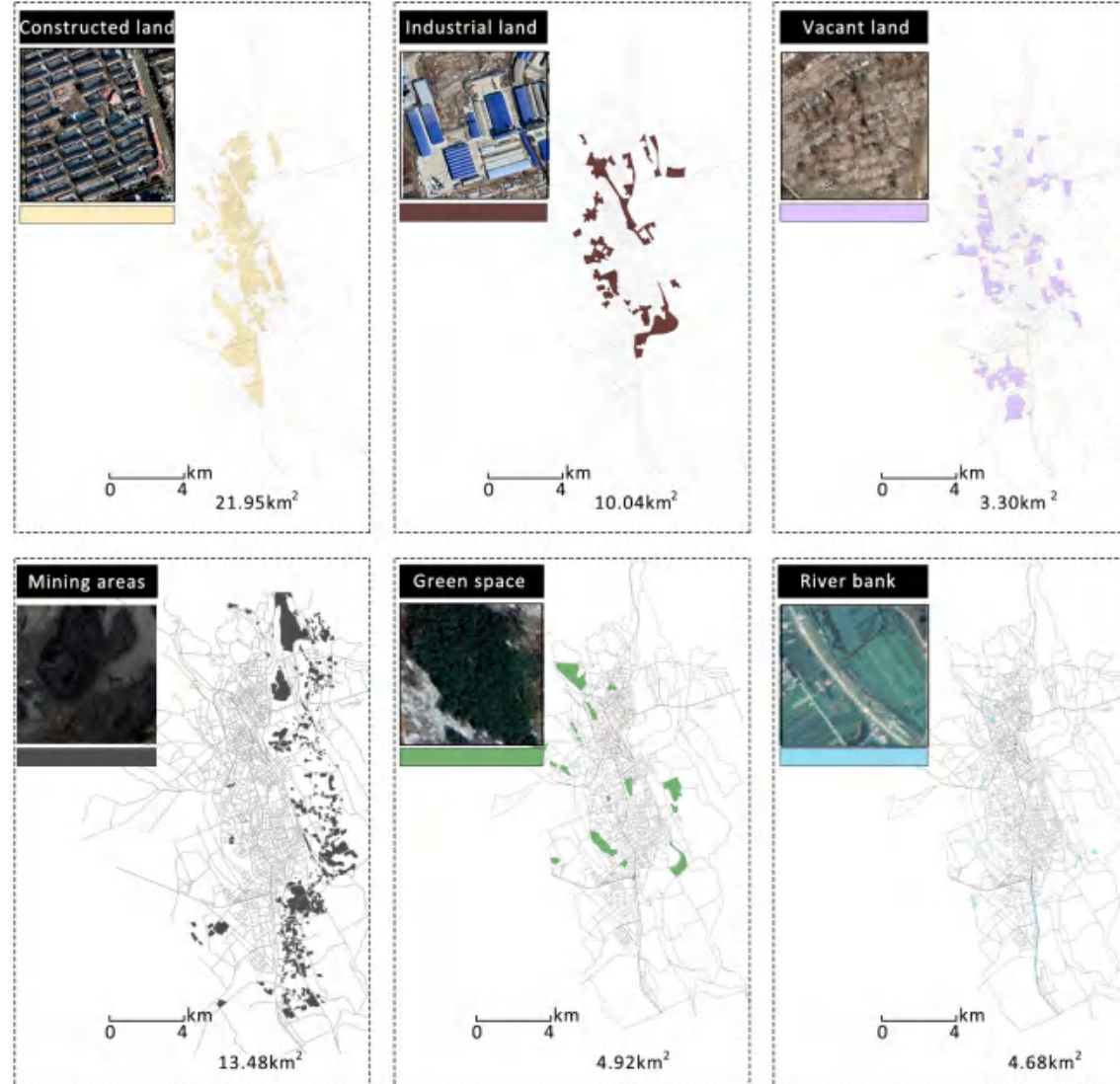
Logo and motif for this design



Chapter 6 Fine-Scale Recognition-Based Design Guidelines for Dealing with Shrinking Cities: A Case Study of Hegang

Shrinking city design

Urban design guidelines



a. Hot spot chart of Baidu Eye

b. Weibo density

The distribution of Baidu Eye (left) and Weibo (right). (a) Hot spot chart of Baidu Eye. (b) Weibo density

Six types of land use identified by remote sensing images



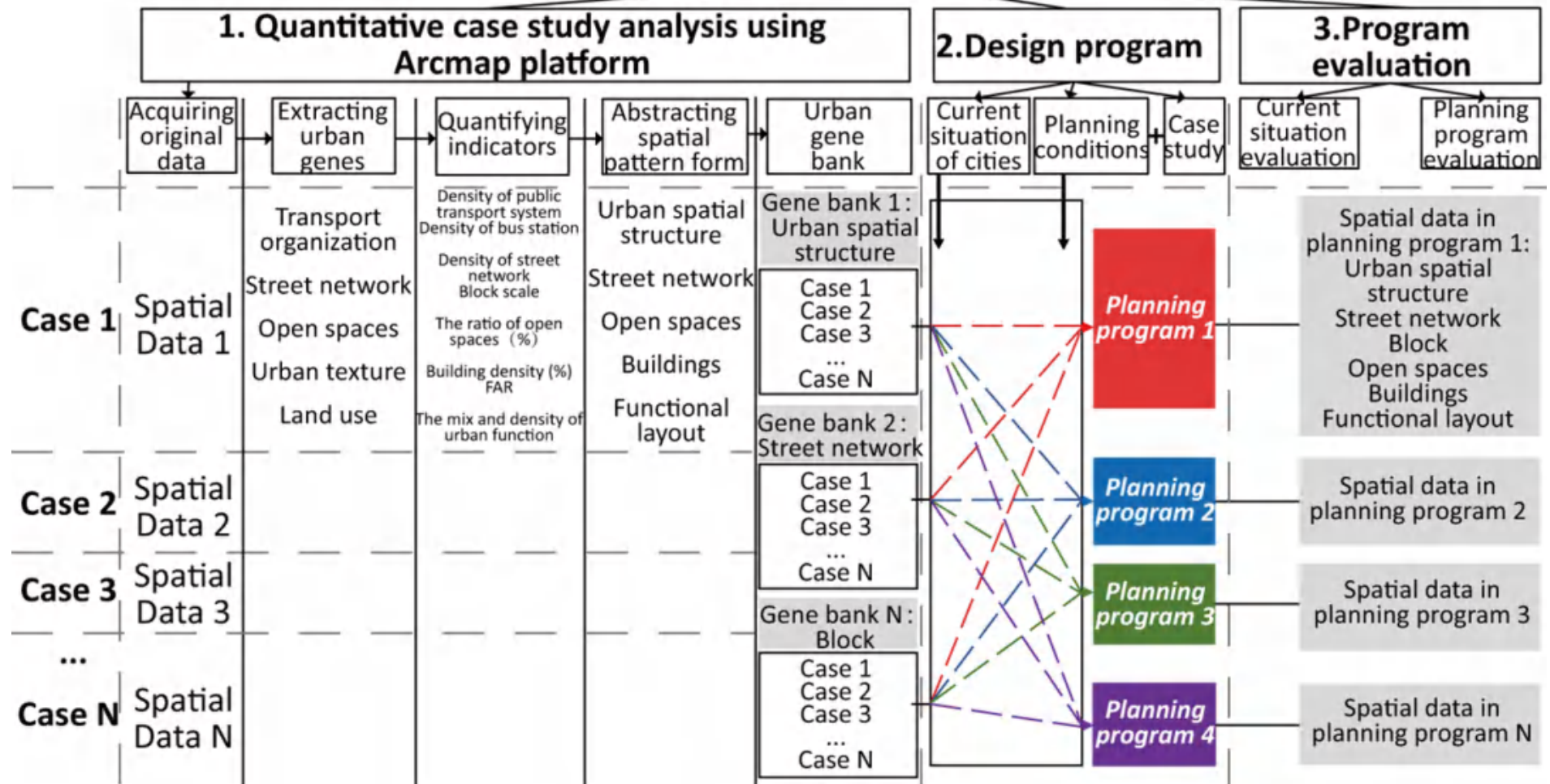
Chapter 7

Quantifying Urban Form as a Case Study in Expansion-Oriented Design: Design Practices in the Tongzhou Subcenter

Expansion-oriented Urban Design

Quantitative case study of similar subcenters

Gene bank of urban form



Research framework



Chapter 8

Defining the Density of the Xiong'an New Area Based on Global Experience



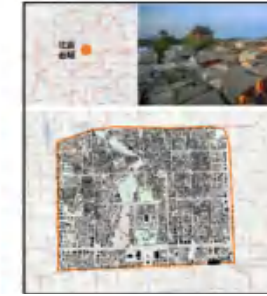
Waitan, Shanghai



French concession, Shanghai



Futian CBD, Shenzhen



Old city, Beijing



Old city, Chendu



Old city, Hangzhou

Quantitative case study of similar functional areas

Various urban form indicators



Potsdam square, Germany



Seashore Bay, Singapore



SOHO areas, London



Knightsbridge, London



Covent Garden, London



St. James, London



Milbank, London



Hamburg Port new town, Germany



Friedrich, Berlin



Atlanta, USA



Saint Louis, USA

Case cities

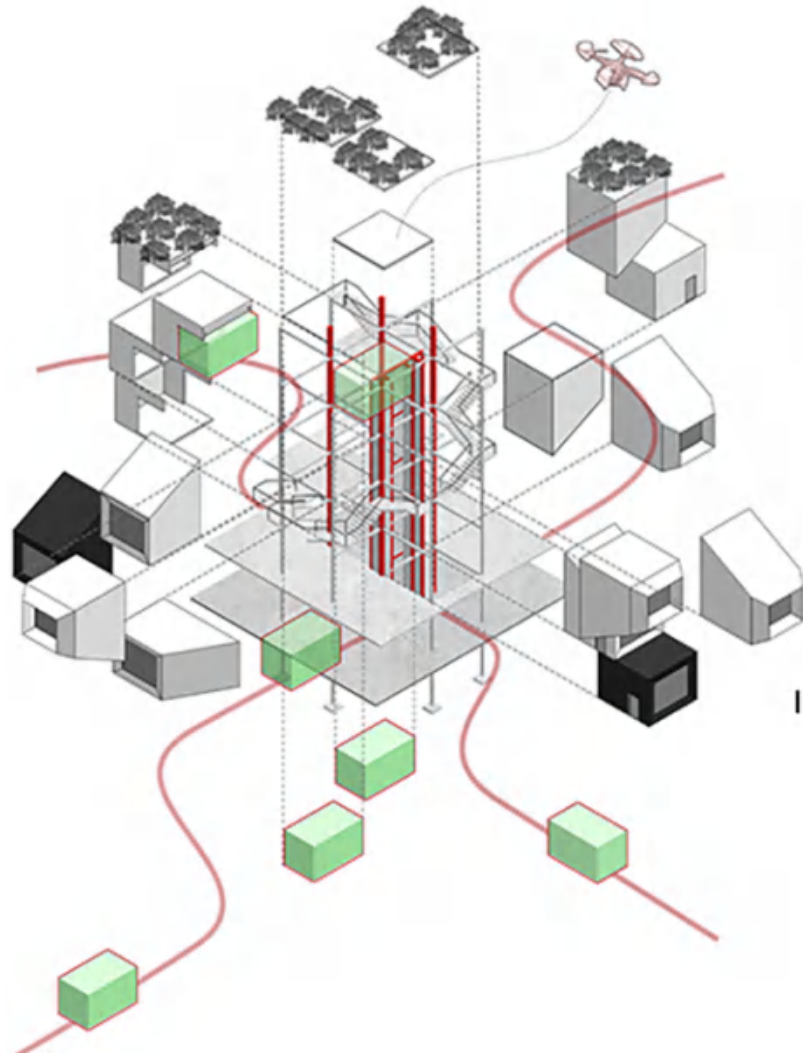
Part IV Embracing Advanced Technologies and Transitioning of Cities into Better Designed Sites



Chapter 9

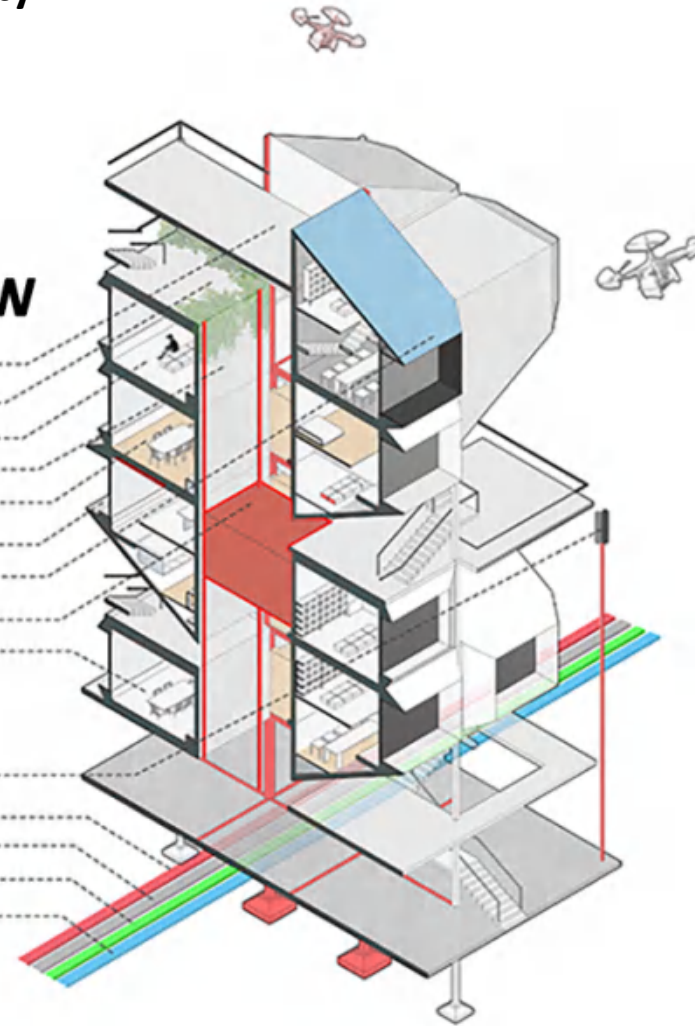
The Next Form of Human Settlement: A Design for Future Yilong City

- Modular buildings
- Various new devices



SECTIONAL VIEW

- UAV receiving station
- Green balcony
- AR experience room
- Function flow shaft
- Restaurant kitchen
- Leisure balcony
- Solar panels
- Functional Box
- SOHO
- Internet of Things sensor
- Information flow
- Drain
- Strong electricity
- Heating

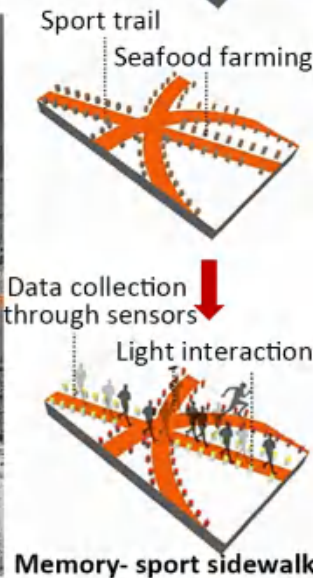


Module combination method and the section of an example

Part IV Embracing Advanced Technologies and Transitioning of Cities into Better Designed Sites

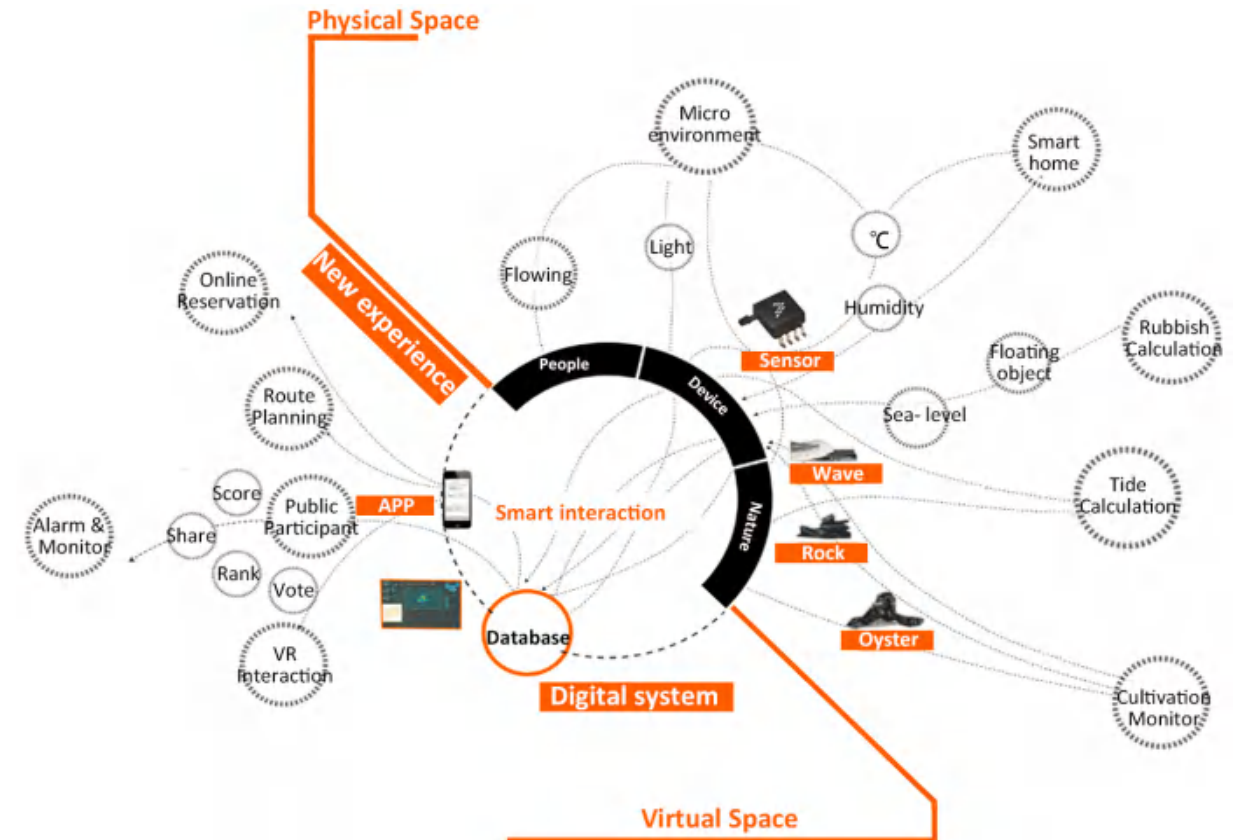
Chapter 10

The Future of the Smart Island: A Design for a Natural and Technological Experience District on Huangguan Island



Nature combined with technology

Virtual and augmented reality



New experience of nature with VR glasses

Smart technologies applied to enhance the interaction between physical and virtual space



3

DAD APPLICATION FOR CREATING FUTURE CITIES



From **Smartly Design** to **Design Smart**



Three Ways to Promote Urban Research and Practice with Emerging Technologies



City Laboratory

Provide new data and method to understand the city

Recognition

Method level



New City

Influence the urban life and urban space

Transition

Cognition level



Future City

Help future-oriented urban planning and design

Creation

Practice level





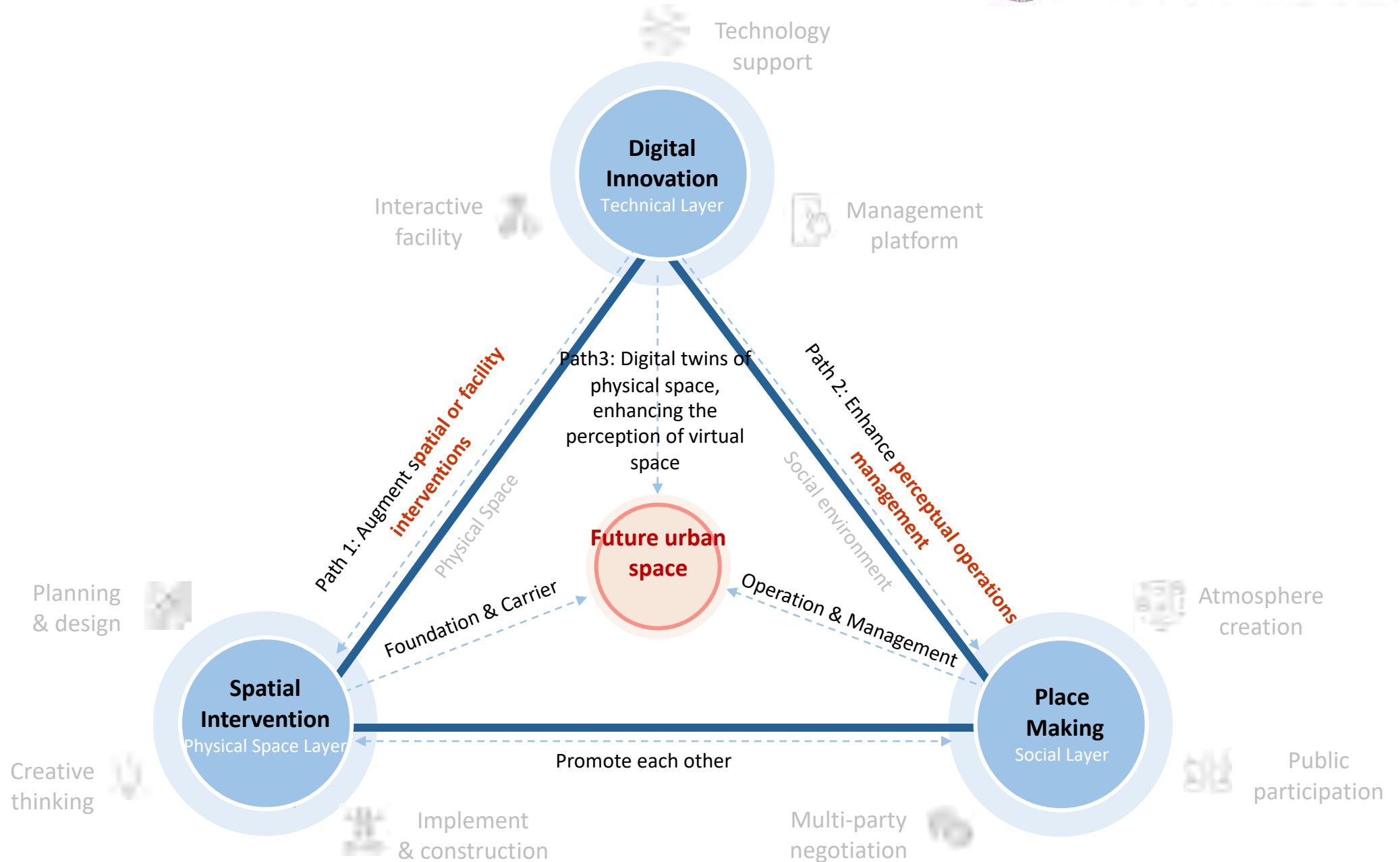
- **Spatial Intervention, Place-Making and Digital Innovation (SIPMDI)**

Spatial Intervention, Place-Making and Digital Innovation (SIPDI) refers to **using various smart methods and intelligent facilities, combined with traditional space intervention and place-making design methods, to create smart urban space.** It aims better to meet the current needs of people's activities, achieve self-adaption and energy-saving, improve the usage and management efficiency of the space, and increase the space's vitality.

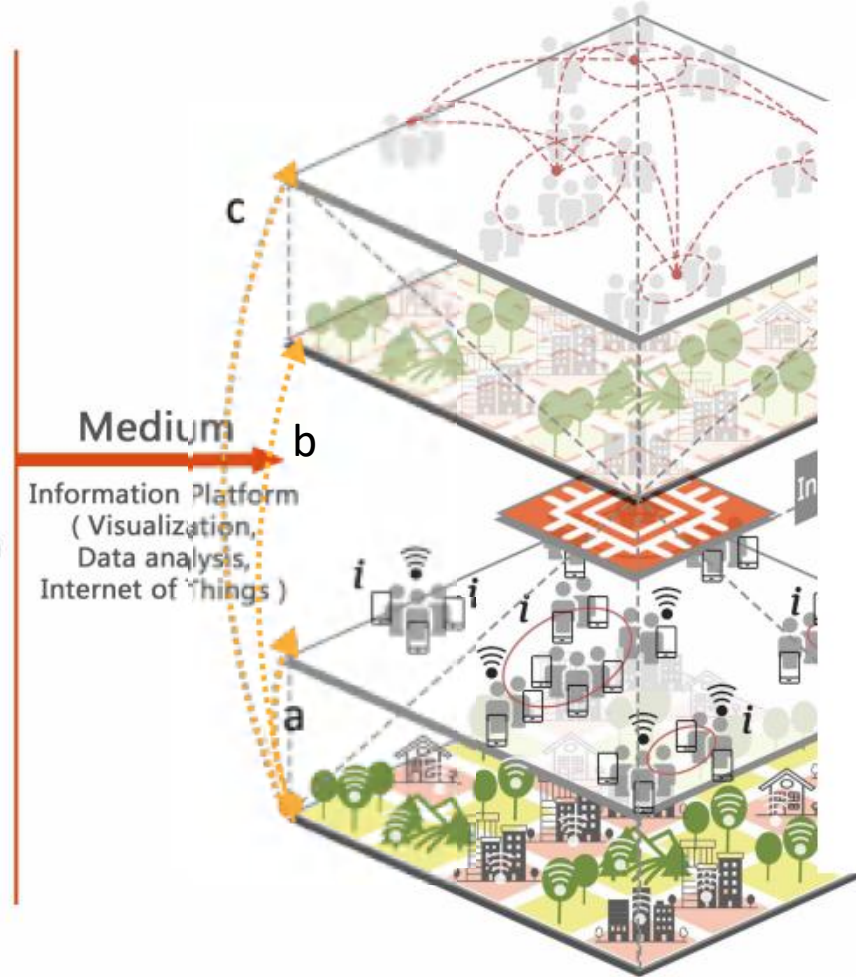
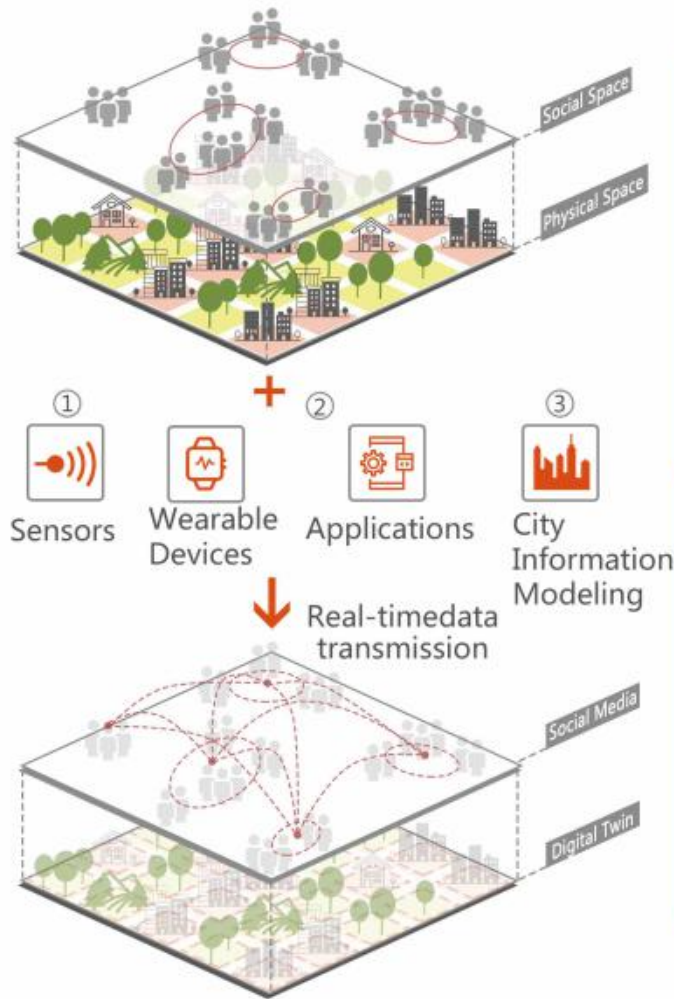


- Urban space mainly covers human-scale urban space elements, including buildings and outdoor public spaces such as green spaces, parks, squares, street nodes, and streets.
- Therefore, "design" includes a broad category of built environment design, including urban design, landscape design, and architectural design.

3 DAD Application for Creating Future Cities



3 DAD Application for Creating Future Cities



- a. Enhanced perception of people in urban space
- b. Digitization and virtualization of urban space
- c. Interaction between urban space and social media
- d. Enhanced interaction between people and urban space
- e. Interaction between human and digital twin space
- f. Human interaction in the social media

双井可持续更新 13社区设计节

区域分析 | REGIONAL ANALYSIS



场地周边位置 | REGIONAL ANALYSIS

场地开掘位置 | LOCATION

理念 | CONCEPT

社区家园 "HOME+"

是公共空间区域的一部分时——
我们渴望重新定义 "HOME" 的概念



客厅的延伸 + 阳台的延伸 + 道路的延伸 + 门户的延伸

场地问题分析 | PROBLEM ANALYSIS

问题 1: 入口单调——入口空间品质及形象亟待提升



问题 3: 垃圾杂物堆积——侵占公共清洁空间, 影响空间品质与使用效率



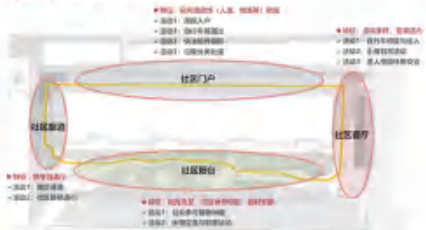
问题 2: 公共空间匮乏——缺乏趣味性的公共清洁及实际可用的体育锻炼



问题 4: 植被覆盖茂盛杂乱——部分遮挡采光, 滋生蚊虫



设计概念 | DESIGN CONCEPT



功能活动分区 | FUNCTIONAL PARTITION



设计意向——总平面示意图 | DESIGN INTENTION—GENERAL PLAN



设计意向——鸟瞰示意 | DESIGN INTENTION—AERIAL VIEW



步道标识系统 | FOOTPATH SYSTEM



社区家园 "HOME+"
双井可持续更新13社区设计节

双井可持续更新 13社区设计节

主要设计节点选择 | The main design nodes



公众参与及活动 | Public participation and activities



场景展示 | Scenes display 节点一: 高质入口



场景展示 | Scenes display 节点二: 休闲平台



场景展示 | Scenes display 节点三: 儿童乐园



场景展示 | Scenes display 节点四: 休闲庭院



场景展示 | Scenes display 节点五: 休闲绿地



其他场景展示 | Other scene displays



植物配置 | Landscaping plants design



社区家园 "HOME+"
双井可持续更新13社区设计节



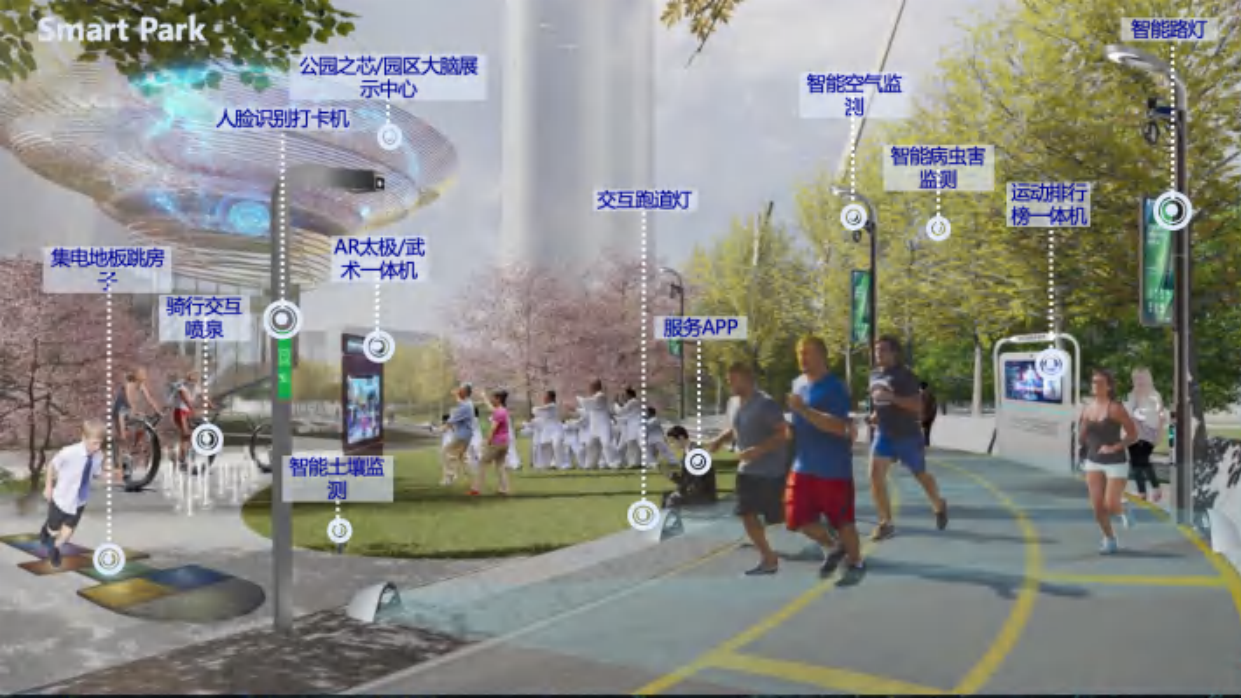


SpaceGo

Analysis on the future spatial development direction of smart city technologies in China



Smart Park

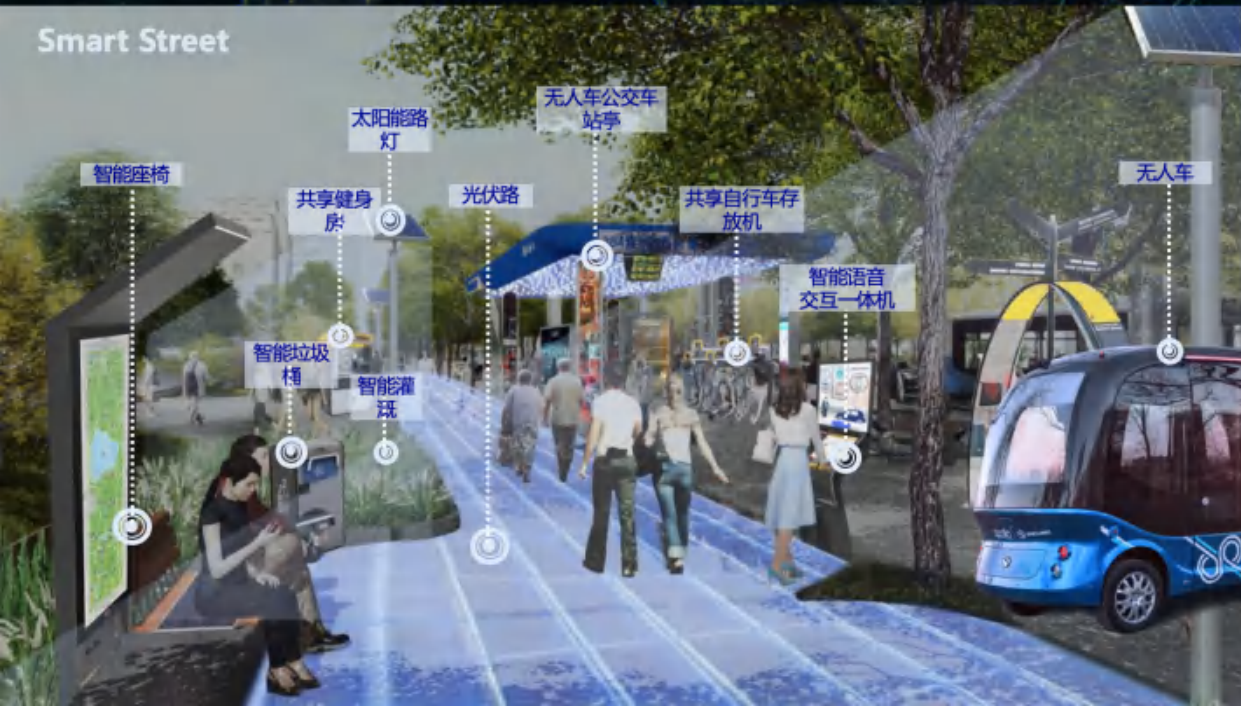


Smart Community

北京甲板智慧科技有限公司 DREAM DECK



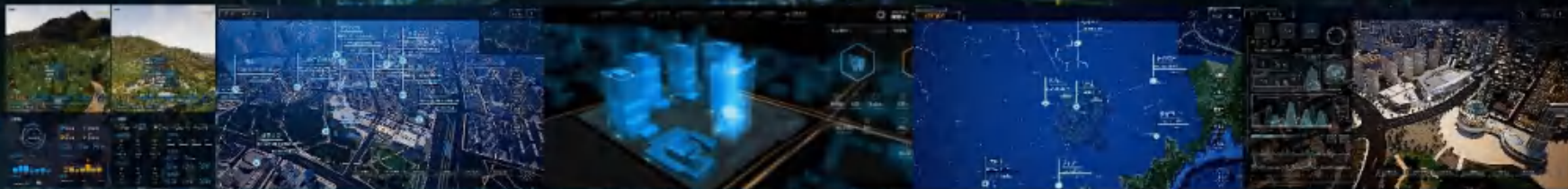
Smart Street



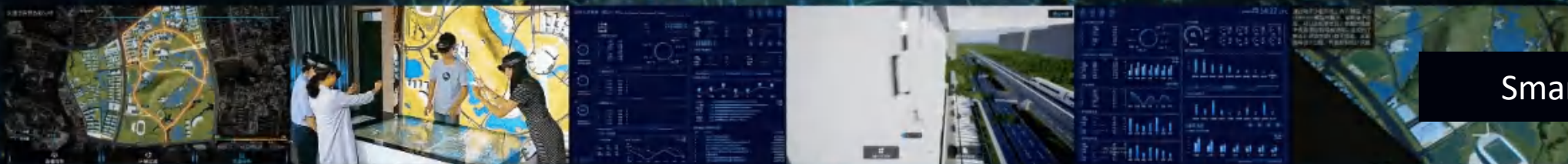
Smart Park



Smart Building



Smart Campus



Smart Waterworks



Smart Travel



Smart Data Analysis





2021 EPMA urban design studio 3



The profile of shared data



The detailed discription for the data.pdf
Adobe Acrobat Document [2.4 MB]

Download

Street view images

Remote sensing images in different years

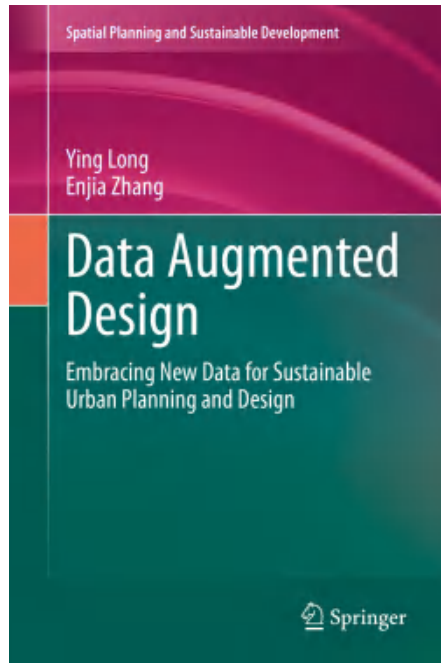
Big/open urban spatial data for our site

Data download:

<https://www.beijingcitylab.com/epma2021>



清华大学建筑学院
School of Architecture, Tsinghua University



Thanks for your attention

Ying Long

School of Architecture, Tsinghua University