



北京城市实验室
Beijing City Lab

ID of the slides

15



Slides of BCL

www.beijingscitylab.com

How to cite

Author(s), Year, Title, Slides at Beijing City Lab, <http://www.beijingscitylab.com>

E.g. Long Y, 2014, Automated identification and characterization of parcels (AICP) with OpenStreetMap and Points of Interest, Slides at Beijing City Lab, <http://www.beijingscitylab.com>

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

Ying Long, Xiaochun Huang, Lianna He, Hui Cheng,
Wencheng Yu, Qiang Wang, Xin Zhang, etc.

Beijing Institute of City Planning, China

1 INTRODUCTION

PSS in China

- Rapid urban expansion in most of cities in China
 - Emerging urban redevelopments in big cities
- Strong urban plan in China aiming to a sustainable development pattern
 - Although limited effectiveness (Han et al, 2009; Long et al, 2012; Tian and Shen, 2011)
- PSS proposed for scientific plans
 - Plan compilation and evaluation
- Increasing PSS community in China
 - See the number of Chinese scholars in this CUPUM

Existing research

- Planning support systems (PSSs), a hot topic
- A large number of existing PSSs
 - E.g. *What If?*, INDEX, Communicy Viz
- Book chapters for various PSSs
 - Brail and Klosterman 2001; Geertman and Stillwell 2003; Brail 2008; Geertman and Stillwell 2009
 - **The book to be edited for CUPUM 2013**

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
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

An inventory of typical PSSs

For planners with a specific background, e.g. architecture

- Which existing PSSs to use?
 - Which models to apply?
 - Which methods to refer to?

New Technology Tools

P
l
a
n
c
o
n
t
e
n
t
s

Tools		Method			Software			Model		
		A	B	C	D	E	F	G	H	I
Strategic plan	Element 1									
	Element 2									
	Element 3									
	Element 4									
Master plan	Element 1									
	Element 2									
	Element 3									
	Element 4									
Detailed plan	Element 1									
	Element 2									
	Element 3									
	Element 4									
Special plan	Element 1									
	Element 2									
	Element 3									
	Element 4									

The simplified PSS framework (for China)

Cells in dark means a **PSS tool**, a method, software or model, could be adopted to support the **plan element**.

2 METHOD & RESULT

Requirement analysis

- Two seminars held in Beijing Institute of City Planning (BICP, over 300 planners, most with architecture background)
 - At the beginning of the research, 10 planners with 20 comments
 - To include more types of plans
 - To include conventional methods / theories
 - The preliminary framework, 20 planners with 30 comments
 - To include existing models in BICP, to reveal data requirements

Requirement analysis – *cont.*

- Online survey
 - 34 responses, out of about 300, from BICP
 - 19 planners had never or seldom applied quantitative methods
 - 30 planners saw opportunities for PSSs to support their work
- Planners in BICP showed great interest in using PSSs in their work, although this is not yet common.

Selecting plan elements

- Existing urban planning laws, regulations and standards in China
- More attention on plan compilation
 - **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.

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

Selecting PSSs

- Quantitative methods
 - that many planners are not familiar with.
 - In textbooks
 - E.g. scenario analysis, system dynamics, genetic algorithm
- Software:
 - Existing PSSs
 - E.g. INDEX, What If? Modules of ArcGIS, SPSS
- Models
 - Developed or to be developed by BICP

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 distribution 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), GWR3X	Land use evolution model, Beijing development analy

Part of the framework we proposed

Based on literature review and plan archive identification

For an example of the plan element “establishing urban growth boundaries” in spatial layout of master plan compilation

- **Data:**
 - 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**
 - cellular automata and trend analysis
- **Software**
 - SWARM, REPAST, NETLOGO and ArcGIS (Spatial Analysis module)
- **Models**
 - Beijing Urban Spatial Development Model (BUDEM), Urban Growth Control Model (UGCM) and Land Use Layout Analysis Model (LULAM)

128 methods

规范经验结合法	指数增长模型	单因子分析法	等值密度法	经验公式法	Wilson模型
情景分析	投入产出分析	圣维南方程	地面漫流模型	景观格局评价	不均衡系数法
多属性评价	人口再分布理论	统计分析方法	Logistic回归	Agent建模法	层次分析法
叠加分析	人口资源承载力分析	托达罗人口流动模型	Logit模型	洪水模拟	产品单耗法
拟合客流法	人工神经网络	系统动力学	SWOT分析	互换论	Clark模型
邻近分析	时间序列分析	现场调研	潮流计算	灰色规划	弹性系数法
相关分析	水力计算	最短路Dijkstra算法	短路电流计算	热负荷折算	生态承载力分析
趋势分析	节点水头平差法	主成分分析	归一化植被指数计算	牛顿模型	市政承载能力分析
辐射区分析	经验分析法	资源综合平衡法	规划综合	帕兰德区位	数学模拟法
核密度分析	基础地形分析	综合分析法	负荷密度法	理论分析	水质模拟
回归分析	灰色系统理论	中心地理论	道路红线优化布置	量纲分析法	天际线分析
聚类分析	模拟退火算法	相性分析	分析优化	廖什原理	同时系数法
平衡计算	刘易斯二元经济模型	循环计算	分形分析	流域划分	推理公式法
最优化理论	空间句法	线性回归法	蒙特卡洛	马尔科夫过程	图纸分析
最优理论	劳瑞模型	遥感解译	坡度分析	零售引力法则	物理模拟法
综合增长率法	公式推理法	文献调研	气量平衡分析	过滤论	网络分析
栅格代数运算	非恒定流水力模型	土地利用演变分析	建面预测法	多目标规划	韦伯区位
重力模型	多智能体系统	视域分析	均衡分布	动态规划	氧源绿地计算方法
遗传算法	Logistic人口模型	试算法	均衡理论	杜能区位	效用理论
元胞自动机	Alonso地租理论	人口预测法	空间插值	非线性规划	线性规划
整数规划	Leslie人口模型	三维分析	空间分析	Voronoi多边形	最小二乘法模型

59 software

ArcGIS	InfoWorks	REPAST	PySa1
AutoCAD	MIKE	SAS	Buffer
Excel	Xpssoftware	奔特力-海思德	Hot spot
SPSS	SWMM	辅助设计程序	Network Analyst
What If	SketchUp	海思德	AgentAnalyst
Overlay	NetSimu	Kernal density	Identity
Spatial Analyst	Envi	AxWoman	ArcGIS (Union)
控规汇总系统	EPAnet	ArcGIS (Buffer)	ECHAM5
Cube	Fragstats	NETLOGO	多点入流汇流计算
Proximity	GeoDA	MATLAB	UC-PSS
BICP 3D	MDPAP	GWR3X	UrbanSim
Trips	CUF	HEC	Vissim
CH规划应用分析工具集	鸿业室外给排水设计	EcoTect	Tranus
3D Analyst	SPSS (Time Series)	MS Word	TREMOVE
Erdas	SWARM	NCAR-CCSM3

58 models

区位分析模型	限建区划定模型	综合费用模型	规划控制线综合模型
用地适宜性分析模型	排水系统模型	文物保护范围评定模型	光污染分析模型
现状综合分析模型	居民居住区位选择模型	土地使用与市政整合模型	宏观交通战略模型
基础地形分析模型	给水管网模型	投入产出模型	用地综合效益评价模型
公共服务设施综合模型	产业区位选择模型	土地利用演变分析模型	城乡一体化评价模型
城市空间发展分析模型	城市空间形态评价模型	生态承载力分析模型	出行链分析模型
交通设施选址模型	房地产价格模型	就业岗位预测模型	低碳城市形态分析模型
人口承载力分析模型	风环境评价模型	就业与产业分析模型	加油站需求预测模型
人口总量预测模型	开发商房地产选址模型	居民就业区位选择模型	生态敏感性评价模型
建筑-用地关联模型	可视性分析模型	交通承载力模型	特色区域分析模型
人口空间分布模拟模型	路网结构评价模型	流域划分模型	停车需求预测模型
规划指标计算模型	路网均衡模型	公共服务设施选址模型	日照分析模型
土地使用与交通整合模型	景观指数综合评价模型	公交IC卡分析模型	噪声分布模型
用地功能布局分析模型	现状与规划比较分析模型	产生-吸引率计算模型
网络优化模型	灾害分布特征及诱因模型	规划单元划分模型



用户 (U) 视图 (S) 帮助 (H)

规划框架支持 Plan element inventory

- 1、规划编制
 - 1 战略规划
 - 1.1 空间发展研究
 - 2 总体规划
 - 2.1 城市总规
 - 2.2 镇总规
 - 3 详细规划
 - 3.1 街区控规
 - 3.2 地块控规
 - 功能定位与规范
 - 地块的主导
 - 用地与建设**
 - 人口与就业
 - 3.3 城市设计
 - 4 市政规划
 - 5 交通规划
 - 6 专项规划
- 2、规划评估
 - 1 总规实施评估
 - 1.1 城市总规评估
 - 产业发展
 - 城市空间布局
 - 城市综合减灾防灾
 - 城镇化与城乡

1. 规划内容 Plan element

用地与建设规模控制

2. 规划内容的具体解释

从综合经济实力和职能定位、交通承载力、公共服务设施承载力、市政设施承载力和环境容量承载力五个方面进行分析，综合确定街区的建设强度，提出开发用地规模、住宅建筑总量

3. 涉及的基础数据 Data

- 等级
- 公共服务设施
- 规模
- 交通基础设施
- 容量等)
- 生态环境容量

5. 涉及的软件 Software

- ArcGIS
- What If?

7. 支持模型 Models

- 规划指标计算模型
- 建筑-用地关联模型
- 人口承载力分析模型

4. 涉及的方法 Methods

- 叠加分析
- 邻近分析
- 情景分析

6. 涉及的工具 Descriptions

- 按照长度百分比统计区域内长度数据
- 按照空间关系关联属性
- 按照面积百分比统计区域内面状数据
- 模糊属性匹配
- 统计建筑高度
- 统计区域高度

3 APPLICATIONS

Applications in BICP

- Applied in BICP, a top official planning agency in China with more than 300 planners, for several months.
- We proposed **7 comprehensive models** to be developed in the future five years in BICP using the framework.
 - According to the requirements of plan compilation and evaluation

Applications in BICP *cont.*

- A training workshop for all planners in BICP.
- It has attracted hundreds of application requests from planners.
 - BICP planners regard the framework as a knowledge base of both **PSSs** and **urban planning theories**.
- Expected to be heavily consumed by planners in BICP.

Application Scene 1

1. Planner A: Working on land use pattern for master plan of an area
2. Planner A: **Found** cellular automata could be applied for simulating future urban growth, on which Planner B has knowledge
3. A **contacted** with B for more information and supervision on the method
4. A was equipped with the method and applied it for supporting plan compilation

Application Scene 2

- Planner A is a land use planner, who is not familiar with the detailed process of urban transportation plan
- A checked the framework we proposed and gain knowledge on urban transportation plan
 - Descriptions, procedures, data, methods, software, models
 - This is **not easy before** even for planners of different majors in the same institute to exchange in-depth knowledge

4 CONCLUSION

Summary

- The first integrated PSS framework for various of Chinese plan types
 - Based on extensive literature review and demand requirement
 - Online version and hardcopy
- Extended planning support tools / PSSs
 - Methods, software, models
- Established timeline for developing models in BICP
- Some preliminary applications from planners
 - From database to knowledge base for PSS and urban plans

Next steps

- Polish the framework in terms of plan elements and tools
- Integrate database into the online query system for knowledge-base
- Develop several proposed models in the framework

Questions?

longying1980@gmail.com