落脚城市 ——博弈论方法在低密度城中村改造中的应用

ARRIVAL CITY — APPLICATION OF THE GAME THEORIES IN RENEWAL OF LOW-DENSITY URBAN VILLAGES

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- ① 本文中, “低技能劳动力”主要指那些人力资本较少或技术熟练程度较低的劳动力人群, 其流动仅具有本地市场效应, 而无明显的知识技术外溢(详见参考文献[13])。
- ② 规模效益可以理解为生产要素在城市大规模集聚和集中所带来的利益。在分摊机制影响下, 人口规模效益表现为对于新增人口所增加的公共服务和基础设施投入要小于现有的平均支出。

1 研究背景

劳动力结构平衡是经济可持续发展的保障。当城市高、低技能劳动力^①数量相当时, 能够形成合理的社会分工, 从而有效提高劳动生产率^[1]。在中国, 受户籍政策影响, 大量低技能劳动人口在城市中租住困难, 阻碍了低技能劳动人群向城市流动。近年来, 与巴西、墨西哥、土耳其等其他经济发展水平相当的国家相比, 中国出现了城市低技能劳动力不足, 而农业劳动人口比重偏高的矛盾^{[2][3]}。据中国国家统计局调查, 63.2%的新生代农民工认为租住问题是制约其在城市落脚的主要因素之一^[4]。因此, 构建经济学原理与城市规划设计之间的联系, 形成合理的规划设计方案, 建立能够满足低技能劳动人口生活和工作需求的“落脚城市”^{[5][6]}, 是本研究的主要目标。

2 解决途径

城中村作为城市扩张过程中形成的残遗斑块, 往往位于城市新区的核心地段。对外来低技能劳动力而言, 由于城中村周边基建

工程与工厂密集、生活零售业需求迫切, 因此就业机会多^[7]。对政府而言, 城中村依靠村民自主投资改造, 以及通过与周边城市建成区共享基础设施, 充分利用了城市规模经济效益^②形成的分摊机制^[1], 在政府财政支出较小的情况下, 为外来低技能劳动力提供了大量的廉价租房。

因此, 在利用城中村区位优势的同时吸引多方投资, 进而形成分摊机制降低政府财政支出, 是解决外来低技能劳动力租住问题的有效途径。在建筑密度与容积率持续增高的前提下, 城中村对低技能劳动人口的容纳力也可以不断加大, 因此本文不对这种现象进行赘述。出于对低技能劳动者居住品质的考量, 本文将研究重点聚焦于低密度城中村, 并尝试借助博弈论预测利益相关主体行为, 构建出平衡多方利益的空间改造模型, 以助力改造的顺利实施^[8]。

3 设计方法

本文以陕西省西安市的一座典型城中村——甘家寨为例, 通过预测西安市未来低技能劳动力总数, 分析整座城市城中村的人

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摘要

本文以低密度城中村改造为研究对象, 利用博弈论等经济学方法对城市的低技能劳动人口容纳空间进行估算, 探讨了城中村改造过程中安置低技能劳动人口的有效途径, 进而为提升城市低技能劳动人口容纳力提供思路, 并以此为基础寻找适宜的规划设计策略。在对陕西省西安市的典型城中村——甘家寨进行改造的案例中, 研究提出了“落脚城市”的设计概念, 并在测算基础上推导出基本空间模式, 试图为中国城中村改造的相关规划设计提供一种“点轴结构、空间模块、共享空间”的设计框架。

关键词

低密度城中村改造; 低技能劳动力; 规模经济效益; 博弈论; 城市规划

ABSTRACT

Offering an alternative planning and design strategy of renewals of low-density urban villages, this research estimates potentials of increasing a city's accommodation capacity of low-skilled labor force through economic approaches like the Game Theories. A design idea of creating an “arrival city” is proposed in the prototypical study on the renewal of the Ganjiazhai Community, a typical urban village in Xi'an City, Shaanxi Province. Developing spatial patterns through a series of evidence-based deductions and estimations, this research forms a node-axis framework of urban planning and design that allows for an adaptive combination of spatial modules and encourages spatial sharing, which might shine a reference for future planning and design of urban villages in Chinese cities.

KEY WORDS

Low-Density Urban Village Renewal; Low-Skilled Labor Force; Merits of Economies of Scale; Game Theories; Urban Planning

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项目地址：

陕西省西安市雁塔区

项目面积：

34.4hm²

项目团队：

赵晨思、刘恺希

设计时间：

2018年4~6月

所获奖项：

第十四届LA先锋奖综合类景观设计奖、表达与模型奖

LOCATION:

Yanta District, Xi'an City, Shaanxi Province

AREA (SIZE):

34.4 hm²

PROJECT TEAM:

Zhao Chensi, Liu Kaixi

DESIGN PERIOD:

April ~ June, 2018

AWARDS:

Landscape Design Award and Graphics and Model Award,
2018 LA Frontiers Award

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口容纳潜力，以得到甘家寨的人口容纳指标，进而构建甘家寨改造利益相关方的博弈模型，分析不同利益主体参与改造的条件，并建立该条件与土地容积率的关系，从而确定建设主导方和资金投入方，并推算出最合理的资金额、容积率及后期管理模式，形成该城中村改造的基本空间模型。最后，通过分析相关人群的行为特点作为空间设计的依据。

4 设计概念及设计过程

据中国科学院中国现代化研究中心预测，中国城镇化率将在2040年超过80%^[9]，届时城镇人口增长将出现停滞或略有下降的趋势，城市人口结构也将趋于稳定^[10]。为了测算2040年时西安的低技能劳动力总数，我们依据经济学家陆铭于《大国大城：当代中国的统一、发展与平衡》一书中提出的人口测算模型，计算出在人口自由流动的情况

下，西安共需630万左右低技能劳动力才能满足经济可持续发展的需求^[11]。

通过测算土地利用混合度、公共交通可达性、建筑密度、距区域中心距离等与低技能劳动者居住质量最为相关的因素对其租房意愿的影响^[12]，并结合各个城中村占地面积，可以判定不同城中村的低技能劳动人口容纳力。甘家寨社区占地面积34.4hm²，现状容积率为1.03，建筑密度约为30%，在西安市所有城中村中属中等偏上规模，目前低技能劳动人口约为一万人^③。甘家寨社区因其地理位置优越（靠近西安高新开发区，交通发达，周边配套设施齐全），对外来低技能劳动人口的吸引力较强，加之目前其建筑密度和容积率较低，因此仍有进一步开发和改造的空间。经推算，2040年时，甘家寨社区将可容纳约两万名低技能劳动人口。

研究基于博弈论理论，对不同改造方案的可行性进行了评估。

4.1 建立基本空间模型

甘家寨改造涉及的主体包括政府、城中村原住民、外来低技能劳动人口，以及开发商。其中，由于外来低技能劳动人口对于改造是否能顺利进行的影响较小，因此不参与博弈，其利益主要由政府通过对其进行意见调查（如询问理想的居住面积或租金）来实现，故将政府、城中村原住民、开发商三者作为博弈模型的主体，推导出三种改造方案：一为在政府规制下，由村民自主投资改造；二为在村民的配合下，由政府投资改造；三为在政府规制与村民配合的情况下，通过出让部分土地给开发商换取资金进行改造。

通过对各方利益进行平衡分析与测算，方案三被最终采纳。通过出让13.4%的土地，并将出让部分容积率限制在3.5来换取改造资金。随后由政府使用这些资金对场地内60%的土地进行分期改造，形成容积率为3.0的基本空间模型。

③ 由于低技能劳动人口的租住位置与其所从事的职业联系密切，因此城中村中低技能劳动人口流动性较强，这里的人口数据是基于调研得到的全年平均常驻外来租住人口。

4.2 优化空间模型与提出设计语言

1) 优化空间模型。根据实地调研得到的结果，对基本空间模型进行优化。

提出规划结构：场地现状结构单一，主要由“两轴”（东侧两条西南－东北向的主商业街）和“一心”（位于村落正中的村委会小广场）组成。东西区域为两个独立的居住区，二者仅通过一组相对的入口相连，割裂明显。因此，设计在这组相对的入口处嵌入了一段连接空间，并将两条无法用于建造房屋的东－西走向地裂带作为公共活动空间的串联轴线，以及在西侧区域的主街置入了一条次级轴线，以形成丰富的空间体验。

确定改造及出让区域：基于基本空间模型的数据限制，对保留、改造及出让区域进行划定。由于场地东南角靠近主干道，公共交通站点密集，路口紧邻大学生创新园区，人流量较大，具有较高的商业价值，因此将其作为出让区块。场地东侧区域目前建筑加建与街道临时搭建行为较多，整体活跃度较高，但街道结构单调，活动空间狭小，因此将其作为改造区域。而西侧区域目前以居住功能为主，商铺较少且商业价值较低，因此将其作为保留区域。

组织功能分区：在竖向设计上，保留场地目前“上住下商”的格局；在平面布局上，强化已有的两条商业街，并使之与出让地块的商业街区形成联系，同时在地裂带上营建新的社区公园与开放街区等公共活动区域。

2) 提出设计语言。在调研的基础上，根据上述结构及分区，提出如下空间形态控制及设计语言：

点轴结构：为打破西侧区域与村落主体隔离的现象，需在东西两侧间以一组串联的小广场形成横向连接轴。同时强化现状西南－东北向商业轴线，并在其两侧有节奏地布置休憩空间。此外，在东西向与南北向轴线交汇处的原村委会小广场附近设置村民活动中心，将城中村的各公共空间集合于此，形成地标。

空间模块：根据城中村居住空间、街道空间、商业空间、入口空间、公共建筑空间、广场/绿地空间等的现状特征与未来需求，对不同功能的模块进行设计。

中心节点：设计将村民活动中心设置为村落的中心节点，并在其中融入菜市场、祠堂、教堂、幼儿园、村委会，以及集合住

宅等功能。此外，通过在村落中心的户外空间提供社火表演及村集体大型集会活动的场地，构建集体记忆点。

5 结语

在对甘家寨进行改造的过程中，我们没有直接从空间角度着手进行规划，而是尝试从经济学视角考量城中村改造成本及承载力，为规划设计方案寻找依据。在博弈论等经济学方法的指导下，我们试图探讨如何为低密度城中村建立最合理的外来低技能劳动人口容纳系统。通过建立从城市整体到某一特定城中村再到村内具体功能空间的土地配置与利用模型，推导出能够帮助平衡城市劳动力结构的低成本－高效益策略。最后，依据模型数据与场地现状，对具体的功能分区与结构形态进行推敲，得出改造方案。

本研究旨在提醒城市规划设计者关注城中村改造的根本目的是解决低技能劳动力的容纳问题，而非现阶段仍占据主流的对空间整洁度及美观度的提升，并强调从城市尺度入手进行统筹布局的重要性，以期为未来的城中村改造探索提供一条可行路径。**LAF**

2. 城中村的优势
3. 甘家寨区位图

2. Advantages of urban villages
3. Site location of the Ganjiazhai Community

3
甘家寨改造规划小图

结果统计 Results

1 {Sg1, Sp1}	×	2 {Sg1, Sp2}	✓
3 {Sg2, Sp1}	×	4 {Sg2, Sp3}	✓
5 {Sg2, Sp2, Sd1}	×	6 {Sg2, Sp2, Sd2}	✓

- 规划策略及过程
- 通过构建博弈模型推导出三种可行的改造方案
- 对三种可行的改造方案进行分析，得到基本空间模型。
- Planning strategy and process
- Three plans generated through a Game simulation
- Through an evaluation of three plans, a spatial zoning plan is formulated.

图 | 甘肃省城市更新规划小组

方案二：政府主导下的开发模式空间示意图
Plan B: Locals-financed renewal led by government

7亿人民币 << 西安政府财政支出
RMB 700 million far less than the expenditure of Government of Xi'an

改造费用最少：7亿人民币
Minimal renewal cost: RMB 700 million

方案三：政府规制下的多方合作机制
Plan C: Developer-financed renewal with all stakeholders' participation

出让土地面积：46 099m²
改造百分比：60%
出让容积率：3.5
改造容积率：3.0
Projected area for new development: 46,099 m²
Renewed coverage: 60%
FAR of the new development area: 3.5
FAR of the renewed area: 3.0

政府节约成本
Saving government's expenditure on urban village renewal

图 | 甘肃省城市更新规划小组

the sharing usage of urban infrastructure are benefited from merits of economies of scale^②, providing many affordable dwellings for low-skilled migrators.

By making use of urban villages' location advantage to attract investment from multiple parties, a sharing mechanism would be formed that helps reduce government expenditure on urban village improvement and provides affordable rental dwellings for migrant low-skilled workers. Differing from conventional practices that simply focus on increasing the density of high-rise buildings to accommodate more residents, this research offers an alternative that improves urban villages' living conditions and public resource sharing (green space, for example) to enhance residents' physical and mental health by building an inclusive community of a relatively lower density. Through an interest-benefit estimation among all stakeholders, this research develops spatial patterns defined by an application of Game Theories, which helps guarantee the implementation of urban village renewals.

3 Methodologies

As a prototypical study, this research estimates the total population demand of low-skilled labor force of the City of Xi'an, Shaanxi Province and the accommodation capacity of urban villages in Xi'an. Then the research examines the existing and potential accommodation capacity of the Ganjiazhai Community, a typical urban village in the Xi'an City through a simulated investment-benefit negotiation among all stakeholders, based on the Game Theories. Finally, a renewal plan is determined, covering land use planning, floor area ratio (FAR), capital amounts, and running and management mechanisms. Through field investigation approaches like mapping residents' behavioral patterns,

功能分区（竖向）
Land use planning (vertical arrangement)

功能分区（平面）
Land use planning (site plan)

② Merits of economies of scale refers to the benefits from a massive gathering and concentration of production factors in a city. Under a sharing mechanism, the merits of scale of population is demonstrated with the fact that a city's investment on public services and infrastructure for its increased population is less than its current expenditure on average.

the plan also develops a series of spatial modules for an adaptive regeneration in the community, which would inform further spatial design at smaller scales.

4 Design Process

The China Modernization Scientific Center of the Chinese Academy of Sciences forecasts China’s urbanization rate of 80% by 2040, when the country’s urban population would stop growing or slightly decline^[10]. The research estimates the total population demand of low-skilled labor force of Xi’an by 2040 through a population measurement model proposed by economist Lu Ming in his book *Great Nation Needs Bigger City*. Results reveal that, considering a population mobility, Xi’an would need 6.3 million low-skilled laborers to support its sustainable economic development^{[11][11]}.

The research, in light of the sizes of urban villages, estimates the population accommodation capacity of each urban village in Xi’an by considering factors that impact the house renting of low-skilled laborers, such as the level of mixed land-use, accessibility to public transportation infrastructure, construction density, and the distance to regional center. Covering an area of 34.4 hm², Ganjiazhai Community now has a FAR of 1.03 and a construction coverage of approximately 30%. As a medium-sized urban village in Xi’an, the community currently homes about 10 thousand low-skilled laborers[®]. Neighboring Xi’an Hi-tech Development Zone with easy access and sound facilities, Ganjiazhai attracts a large number of low-skilled migrators. Given the current low construction density and FAR, the community shows itself a great potential in accommodating more migrants. It is estimated that the community could home about 20 thousand residents by 2040, through renewal and redevelopment methods.

Based on the Game Theories, the

research examines the feasibilities of different renewal plans.

4.1 Spatial Zoning Planning

Agents in the renewal of Ganjiazhai Community include the government, local residents, low-skilled migrators, and developers. Given low-skilled laborers less impact on the renewal process, they are not included in the simulation of investment-benefit negotiation, and their interests and concerns (living environment, area, supporting facilities, and rental, for example) can be collected through opinion

- ③ Low-skilled workers have a high mobility and often select their living places for occupational reasons. The demographic data referred here is based on an average estimation of the migrant population in Xi’an.
7. 根据甘家寨场地现状及其点轴结构确定改造及出让区域

8. 甘家寨改造方案竖向及平面功能分区

9. 甘家寨改造方案平面图

7. Analyses of projected renewal and new development areas

8. Vertical and layout arrangement of land use planning

9. Master plan of the renewal of the Ganjiazhai Community

polls and represented by the government. Thus, a Game model is established among the government, local residents, and developers, through which three renewal plans are generated:

Plan A: Government-planning and locals-financed renewal;

Plan B: Locals-financed renewal led by government;

And, Plan C: Developer-financed renewal with all stakeholders' participation.

After a series of evidence-based deduction and estimation, Plan C is adopted, according to which 13.4% of the site land will be occupied with new developments with a FAR of 3.5. Government then could use developers' capital for a phased renewal of 60% of land of the site, with a FAR of 3.0.

4.2 Spatial Design

1) Optimization of spatial pattern. Based on an investigation on residents' behavioral habits, the plan improves and re-organizes the spatial pattern of the community to encourage a more adaptive and dynamic usage.

Structure planning: The current main spatial structure consists of two southwest-northeast commercial streets in the east part and a village hall in the community center. There are two separated residential zones in the east and the west, which are connected with simple accesses. The design transforms the accesses into a relinked public space, introduces a recreational axis on the east-west taphrogenic belt where is not suitable for building construction, and reclaims the main street in the west as a secondary axis to enrich streetscape and landscape experience.

Identifying areas for renewal and new development: In this case, the areas for preservation, renewal, and new development are identified according to the requirements of spatial zoning.

The southeast area of the site neighbors the primary city road, public transport stations, and a university innovation park and enjoys a high pedestrian volume, where it shows a commercial quality for development projects. The eastern part of the site sees illegal and temporary structures and fragmented recreational space but a vibrant usage, which is projected as renewal areas. The western part is occupied for residential uses with less shops and a lower commercial value, which is therefore identified as the preserved area.

Functional planning: Vertically, the existing storefront-residential buildings are preserved; and, horizontally, the two commercial streets are further profiled to enhance the connection with the new development area. Besides, public space such as community gardens and secondary streets are introduced on the taphrogenic belt.

2) Spatial elements: The plan reorganizes the spatial elements of the community to encourage social and cultural interactions.

Node-axis framework: A group of small public spaces are linked up with a west-east axis to integrate the separated western area into the community. At the same time, leisure and recreational space are combined into the southwest-northeast commercial axis to facilitate social activities. A new recreational center would be built at the junction of the east-west axis and south-north axis, i.e. the site of the existing village hall, to form a gathering place and a landmark for the community.

Spatial modules: A series of spatial modules are developed allowing for different function demands and adaptive combinations, which can be integrated with residential space, streets, commercial space, entrances, public buildings and facilities, and squares or greenbelts in the urban village.

The heart of the community: The proposed recreational center is also expected to integrate with a local market, an ancestral hall, a church, a kindergarten, the village council, and residential buildings. The outdoor space of the recreational center can be used to host fire shows and gathering events, celebrating collective memories of the community.

5 Conclusions

Instead of a direct spatial planning, the research attempts to offer an alternative planning concept for urban village renewals through approaches of Economics, which focuses on the real affordability and accommodation capacity of the Ganjiazhai Community. Under principles of the Game Theories, the research explores how to establish inclusive urban villages to home low-skilled migrants in a low-density living environment. By studying land allocation and spatial utilization across scales — from examining a national population hierarchy to estimating potential accommodation capacity of specific communities — a high cost-efficiency renewal strategy is proposed that helps balance the labor force structure of a city. Combining local settings and conditions, the final renewal plan covers specific functional planning and spatial forms based on evidence-based deductions and estimations.

This research is expected to remind urban planners that the primary objective of urban village renewals is to increase the accommodation capacity of low-skilled laborers, rather than to create a tidy image. The research highlights the importance of employing a comprehensive and integrated concept in urban planning, while proposing a roadmap for similar renewals of urban villages in Chinese cities. **LAF**

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10. 甘家寨改造方案空间模块类型

10. Spatial modules