

## Public Service Facilities Implantation Mode Research For Existing Communities Based on ArcGIS Analysis

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### Abstract

*China's urban construction has come to the stage of refined regeneration after a period of decades of rapid urbanization. While the existing communities' regeneration is facing more competitions. As one of the most important subjects in city regeneration, to perfect public service facilities' distribution and to improve its quality are two main jobs. However, there is no surplus land to construct big facilities' buildings, besides, inhabitants' needs tend to be diversified. The discrepancy between these two aspects has become one important problem in existing communities' regeneration. Based on it, this paper proposes a mode of implanting public service facilities into the existing communities which mainly contains two aspects. In terms of function, filter and classify the public facilities which can activate communities' vitality, then analysis different kinds of current facilities' deficiency by ArcGIS to make a decision of facilities' types. In terms of space, there mainly contains three parts. First of all, do typological analysis of existing communities' space, then, design corresponding implantation strategy for each type, taking facilities' function, such as restaurant and retail business, beauty salon, small theatre, tea house, etc. into consideration. At last, combing the existing communities' structure, make sure these public facilities open to the city rather than the residents only, and open to all ages. As result, create a public place shared by the whole city. This study's final goal is to try to offer a new mode of existing communities' regeneration and to provide a reference for making and revising related norms.*

**Keyword:** public facilities, existing communities, mode, ArcGIS analysis

### Introduction

According to "China Statistical Yearbook 2020", China's urbanization rate has reached 60.6%. That means China's urban construction has come to the stage of refined regeneration. While the existing communities' regeneration is facing more competitions. The contradiction lies in that there is no extra land in big cities to construct big facilities' buildings and that people's needs tend to be diversified. Based on the clear understanding of this contradiction, this paper proposes a mode of implanting public facilities into the existing communities. First of all, this paper reviews current relevant research. In the second part, this paper filter and classify the public facilities among relevant codes which can activate communities' vitality. Then analysis different kinds of current facilities' deficiency by ArcGIS to make a final decision of facilities' function. After the facilities' function analysis, this paper did typological analysis of existing communities' space. In the third part, the first step is according to the results of existing communities' space classification, designing corresponding implantation strategy for each type, taking facilities' function, such as restaurant and retail

business, beauty salon, small theatre, tea house, etc. into consideration. The next step is combing the existing communities' structure to create a super walkable block. At the same time, make sure the implanted facilities open to the walking system. The final purpose is to discover a new way to guide the existing communities' regeneration and to provide a reference for making and revising related norms. Therefore, this research has an innovative significance in the regeneration of existing communities.

## **Background**

Community is the basic unit carrying residents' life, and community issues have always been in an important position and have received continuous attention at home and abroad. This part reviews current relevant researches in the field of communities which contains three parts: 1 Community issues get a lot of attention; 2 Construction and research of community-life circle; 3 Community public facility plays an important role in the process of community-life circle construction.

### **Community issues get a lot of attention**

From an international perspective, Community renewal in the United States is a system that combines government legislation, local communities, non-profit organizations, and market forces to promote community development (Wang, 2020). In response to the problem of aging, the United States has also proposed CCRC and NORC to promote the construction of local elderly care systems (Zhai et al., 2020 and Tang et al.,2018). South Korea's "Seoul 2020" master plan puts forward the development vision of a "community-oriented city". Its "Seoul Habitat City Plan" in 2010 emphasized the partnership between residents, government and communities (Im Sik Cho et al.,2017). Singapore divides community public service facilities into three levels: district - new town – neighbourhood centre (Li et al.,2017). The neighbourhood centre is a comprehensive building that provides community residents with "one-stop" supporting life service facilities that integrate various functions. The "multi-generation house" in Germany aims at promoting "intergenerational integration", promotes the construction of community public service facilities, and pays attention to the three key points of openness of facilities, public space and overall design (Yao et al.,2018). From domestic perspective, from the Sixth Plenary Session of the Sixteenth Central Committee of the Communist Party of China in 2006 to the Fifth Plenary Session of the Nineteenth Central Committee in 2020, China proposes to build a new type of urbanization centred on people. Since then, the country and various regions have successively issued a number of norms and guidelines on community construction to perfect communities' public service facilities, build beautiful and liveable communities and promote the creation of community-life circle.

### **Construction and research of community-life circle**

The community life circle focuses on people's daily life, starting from the demand-oriented point of view, aiming at the construction of the overall community environment, and emphasizing the configuration of public spaces and public service facilities. In December 2018, the Ministry of Housing and Urban-rural

Development revised “Standard for urban residential area planning and design (GB 50180-2018)”. Formally write "Building a Life Circle" into the national standard. Subsequently, guidelines for the construction of life circles have been introduced throughout the country. At present, many domestic cities such as Shanghai, Beijing, Haikou, Guangzhou, Beijing, Changsha, Hangzhou, Wuhan, Jinan, Xiamen and other cities have put forward their local life circle construction goals. At the same time, domestic academia has carried out relevant research on the construction of life circle. These studies can be divided into three directions: related indicators of life circle (Chai et al.,2019 and Wu et al., 2020), the relationship between life circle and walking (Wu et al., 2020 and Liu et al., 2020), public service facilities required by residents (Li,2017 and Liu et al., 2020 and Wang, 2020 and Lin, 2019).

### **Community public facility plays an important role in the process of community-life circle construction**

Public service facilities are the most basic carrier of urban social services. Public service facilities and public spaces are the key to improving the quality of life in residential communities (Li,2017). Existing problems of public service facilities mainly include: uneven (Xie et al.,2014), insufficient openness, non-full age (Chen et al.,2021).


### **Methodology**

The method of this paper has three parts: Function research of public service facilities, Classification of existing community spaces, Combing of existing community structure.

### **Function research of public service facilities**

This part is divided into two steps. Step1, study classification and configuration of public service facilities in relevant codes, then select service facilities that related to daily activities. About the choice of codes, two factors are mainly considered: priority and frontier. Thus, this paper chooses one national code and one Shanghai local code: “ Standard for urban residential area planning and design (GB 50180-2018)”, “Shanghai Planning Guidance of 15-Minute Community-life Circle”. On the basis of the screening and summarizing codes’ public service facilities, according to Maslow’s demand theory, considering the influence of age, the results of the public service facilities’ function are shown in Table1. Step2, analysis different kinds of current facilities’ deficiency by ArcGIS.

**Table 1. Screening and summarizing of facilities’ function**

Use priority	Classification of facilities	Specific function	usage frequency
↑	Culture	Small Theatre Small Movie Theatre Community City Exhibition Hall Community Library Cultural Activity Centre	

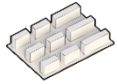
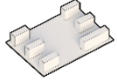

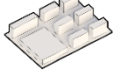


		Youth Activity Centre Multifunctional Activity Centre Cultural Events Station		
	Education	Adult Education Senior Education Vocational Training Centre Community college Extracurricular training for children Early Learning Centre		
	Service	Indoor Playground Outdoor Playground Outdoor Gym Rides Community Service Station Parking Lot Bus Stop Public Toilet		
	Elderly	Elderly Health Centre Community Nursing Home Elderly Care Centre Day Care centre		
	Medicine	Community Hospital Community Health Point Pharmacy		
	Commerce	KTV, Chess and Card Room Coffee, Tea Room Foot Massage, Body Massage Barber Shop Small Business Outlets Community Canteen Vegetable Market		

### Classification of existing community spaces

As shown in Table 2, after typological analysis of the communities' space, five basic types that can be implanted public service facilities are derived: building complexes, fragmented space reuse, bottom function replacement, and original facility expansion, interface construction (including inner and outer streets).

**Table 2. Classification of the existing communities' space**


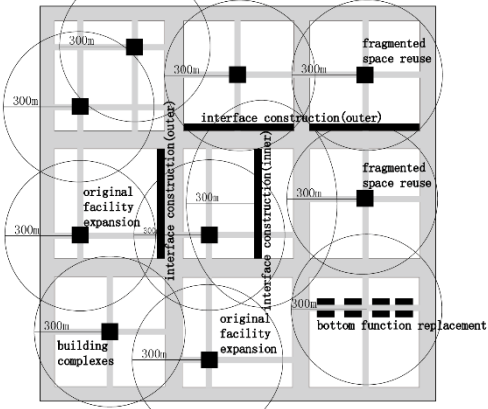
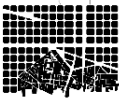

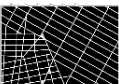

Classification	Description	Diagram
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1 building complexes	In this type, the existing community land is extremely tight, and there is no spare land for construction. Therefore, certain buildings are selected for renovation and interconnected to form a service complex.	
2 fragmented space reuse	This type is using fragmented vacant land to build new service facilities.	
3 bottom function replacement	This type focuses to the high-rise buildings in community, replace the functions of the bottom three floors or less of the high-rise buildings with service functions.	
4 original facility expansion	This type is that there are public service facilities in the existing community, but the functions are not perfect. Therefore, reconstruction and expansion are carried out to increase the required facility functions.	
5a interface construction(inner)	This type is aimed at the street renewal inside the community, combined with the replacement of the underlying functions, to create the street public space.	
5b interface construction(outer)	This type is the same as type 5, but it is mainly aimed at the renewal of the roads and streets in the city.	

### Combing of existing community structure

Street blocks in China are relatively large compared to Hong Kong and other countries. Therefore, these blocks need secondary division. Thus, the final part is combing the existing communities' structure, as shown in table 3.

**Table 3. Diagram of second division of existing communities' block**

Block location	Block diagram	Average block size	Diagram of combing the structure
Shanghai, China		280 x 300 m	 <p>Location of implantable facilities are determined by walking distance. Average walking speed of Chinese people is 1.22m/s. Five-minute walking distance is 370m. Considering the turning of the road, 300m is selected as service radius.</p>
Barcelona, Spain		50 x 110 m	
Hongkong, China		50 x 100 m	
New York, USA		70 x 120 m	
Pairs, France		50 x 80 m	







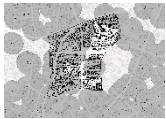

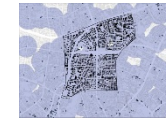
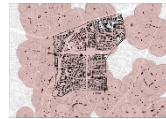


## Results and Discussions

Based on the above theoretical research, this paper selects Qu Yang Street area in Hong Kou District, Shanghai, as an empirical study. This part analysis current public service facilities and existing communities' space of Qu Yang Street area.

### Spatial distribution of existing public service facilities

According to the captured POI data of the Gaode map, different functions of current facilities are analysed by ArcGIS. The coverage was decided as a radius of 300 meters. The results are shown in table 4.

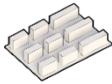
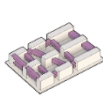
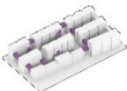



**Table 4. Service scope of existing community public service facilities**



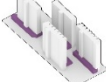
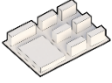

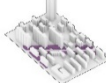


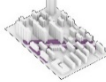
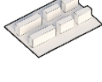

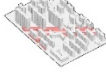
Type	Public restroom	Health care facilities	Training institutions	Living market	Sports facilities	Cultural facilities
Distribution						
Coverage						
Results	This kind of facility <b>achieve most coverage</b> , should be increased appropriately	This facility are <b>insufficient</b> . Focus on adding such facilities.	This kind of facility's are <b>monotonous</b> . Should increase functional diversity.	This kind of facility achieves <b>full coverage</b>	This kind of facility <b>achieve most coverage</b> , should be increased appropriately	This facility are <b>insufficient</b> . Focus on adding such facilities.

### Public service facilities implantation strategy

The types of spaces which public service facilities can be implanted in are studied. Based on this, the corresponding public service facilities implantation strategies are proposed for each type. Then, according to the proposed strategy, the empirical design of Qu Yang Street area community is carried out. Through empirical design, the feasibility of implantable public service facilities is confirmed. Implantable public service facilities can be designed flexibly according to the actual situation, as shown in Table 5.

**Table 5. Model of Implanted Public Facilities**

	Classification of existing communities' space	Public service facilities space implantation mode		Empirical design
1 building complexes			Add veranda to connect the original building, forming a community public service facilities complex.	
2 fragmented space reuse			Built facilities on the fragmented open space, avoiding affecting the living conditions of the original residence.	

3 bottom function replacement			Select the space below three floors of the original high-rise building, increase volume according to the layout, and replace the original functions.	
4 original facility expansion			Renewal existing facilities, using the original structure or new structure. According to the specific situation, space addition can be divided into top layer, side layer and bottom layer.	
5a interface construction(inner)			Reshape the inner street interface. Replace the functions of the ground floor on both sides of the street and add the building volume.	
5b interface construction(outer)			Reshape the outer street interface. Replace the functions of the ground floor on both sides of the street and add the building volume.	

### Location and connection system of implantable public service facilities

According to the block size analysis before, the average scale of Qu Yang Street area is much larger than other cities. Therefore, in the empirical design, the blocks are further divided into units. After division, each unit has its own security system and public space. Newly added road, the current inner road and the urban roads together form pedestrian network. The implantable public service facilities become the nodes of the network, as shown in Figure 1.



**Figure 1.** The Second Plot Division of Existing Community. This photograph was drawn by the author.

### Conclusions

The renewal of existing communities in large cities in China faces many challenges. Perfecting public service facilities' distribution and improving its quality are two main subjects. However, tight land resources and diversified residents' needs have become obvious contradiction. How to preserve the original living habits of the city, at the same time, perfecting public services facilities, promoting the vitality of the streets and improving living standards of residents are the main points that we have to consider. The implantation strategy of public service facilities proposed in this article attempts to explore a new mode of existing

community regeneration, guides existing community regeneration, promotes urban vitality and provides reference for the formulation and improvement of related policies.

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