

Evaluation of Site Resilience Based on Social Capital Theory: A Case Study of Dongsi district

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Abstract. Along with the outbreak of COVID-19 in China, numerous of small and medium-sized enterprises are losing their customers, confronted with the risk of bankruptcy, and communication among the public also witnesses a drop attributed to epidemic prevention policy, which can both be describe as the decrease of social capital. Although the research on resilience city theory is mounting in recent years, there are only a few papers focus on resilience city based on social capital. This paper will build a method analyzing the resilience of Dongsi district from three different perspectives, including enterprises perspective, enterprises and individuals' perspective and individuals' perspective. In this process, data of enterprises and public space's location will be collected, utilizing kernel density tool in Arcgis and Daily average population heat diagram to evaluate the resilience of enterprises and community of Dongsi district respectively. The result shows that the resilience of Dongsi district is low. Enterprises far from streets are devoid of social capital because of the location of some enterprises are disperse and customers flow are low. Additionally, the public spaces, which can promote the communication between local residents, like squares and parks in the site are in small quantity and public show less interest in four attractions inside Dongsi area, indicating that Dongsi is more vulnerable faced to disasters due to the low cohesion among the community.

Keywords: Resilience City, Social capital, Urban planning, COVID-19.

1. Introduction

Due to the harmful effect brought by COVID-19, the public are forced to wear masks, vastly hindering the communication between each other, which causes the low vitality of urban space and indifferent neighborhood relationship. At the same time, COVID-19 is also detrimental to industries, which are facing the risk of bankruptcy in various regions. Although the epidemic situation has been controlled to some extent, how to ensure that all industries and communities can still maintain normal function when confronted by the impact of epidemic situation or other disasters in the future is still a topic that need in-depth study.

1.1 Resilience city theory

Resilience is an efficient urban planning theory facing disasters in recent years. Resilience theory was put forward by Holling, who believes that resilience is the ability of the system to maintain or return to its original state when it is disturbed by external factors [1]. In 1973, Holling introduced this theory into ecology field for the first time, aiming to describe the characteristics of the stable state of ecosystems, before his theory gradually penetrated into the field of social and urban system.

In 2002, United Nations Summit on Sustainable Development introduced the concept of resilience into the city planning and disaster sphere, which set off the prevalent trend of resilience research. Recently, Chinese scholars are devoting themselves into comprehensive energy system, urban infrastructure, transportation system, Urban and rural planning and underground space utilization, using the research on resilience city [2].

1.2 Social capital theory and Resilience city theory

Social capital refers to the state and characteristics of the close contact between social subjects which include individuals, groups, society and even the state, manifestations of social capital include social network, norms, trust, authority, consensus of actions and social morality. Social capital exists

in places where the public can interact and build relationship with each other, containing offices, congregations and communities [3].

Social capital also plays a certain role in strengthening resilience of enterprises and communities. For the enterprises, social capital can be directly used as an input of the economic production, which is beneficial to enterprises productivity [4]. For communities, society reflects people's social relations, trust and common values, which are conducive to social cohesion [5]. Enterprises productivity and social cohesion are key factors in the improvement of resilience, so it is important to integrate social capital theory into resilience city theory.

1.3 The importance of small and medium-sized enterprises and communities

Small and medium-sized enterprises are important in China's national economic and social development, and their healthy development is an important factor in promoting China's economic development, ensuring national employment and economic income, and maintaining social stability. However, compared with leading enterprises, small and medium-sized enterprises are more fragile, which mean these enterprises are more vulnerable confronted by COVID-19 [6].

Community is the external environment of people's life with a large population living in. Joint defense and control mechanism of the State Council made a statement in 2020 that promoting the normalization of community prevention and control COVID-19 was the primary task of current community work. The protection of the life safety and health safety of residents was also significant, only when the community was safe can the normal production and living order be restored better and earlier. Nevertheless, communities with poor resilience are more likely to be defeated by severe disasters like COVID-19 [7].

In general, it is important to construct a resilience evaluation standard, trying to find and improve the existing issues in small and medium-sized enterprises and communities.

1.4 Relevant policies for the construction resilient city in Beijing

Beijing, as a cosmopolis and the capital city of China, has a special status, a complex urban system, various risks and challenges, which means when encountering disasters like COVID-19, Beijing is more likely to have chain reaction and amplification effect. In < Urban master plan of Beijing (2016-2035)>, it clearly puts out the requirement of the resilient city's construction and strengthen the safeguard of various facilities.

Recently, the Beijing Municipal Party Committee and Municipal Government jointly issued <Guiding Opinions on Accelerating the Construction of Resilient Cities>. The guidance takes emergencies as the traction, bases on natural disasters, safe production, public health and other public safety fields, and plans to improve the entire resilience of the city from the whole process of urban planning, construction and management, accelerating the construction of a resilient city.

2. Literature review

2.1 Researches on resilience city

Affected by COVID-19 and other natural disasters, the researches on resilience city are generally increasing. University at Buffalo, the State University of New York had developed the resilience index which included regional economic attribute, social-demographic attribute and community connectivity [8]. In 2018, the United Nations released the standard indicators of resilient cities applicable to the whole world, which theme is "ISO City Indicator Standards", aiming to ask experts and urban planners for detail opinions on ISO. In terms of the resilience assessment, Abbas Ostadtaghizadeh and his teammates proposed a five-dimensional resilience evaluation model at the macro level, including physical resilience, natural resilience, economic resilience, Institutional resilience and social resilience [9]. At present, researches of resilience city in China are still in infancy

period. However, relative papers in resilience aspects are on the rise year by year showing in Figure 1.

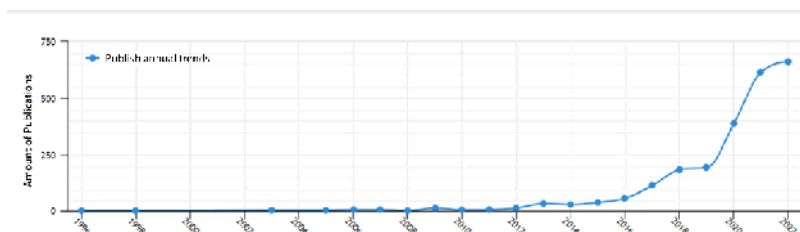


Figure 1. Trends in the number of published dissertations with "resilient city/urban resilience" as the theme or key word (Source: CNKI database)

Rihui Tan et al put forward comments on the resilient construction of Beijing sub-center based on digital platform [10]. Kejing Lu and Zhongwei Luo research on the small and medium-sized manufacturing industries facing the environmental mutation, founding and analysing the different coping strategy that used by small and medium-sized manufacturing industries in different period of environmental mutation, which makes contributions to the development of those industries [11]. Wentao Xiao and Lu Wang, according to China's actual situation, divided the city's resilience into six dimensions: social synergy, environmental adaptability, technical intelligence, engineering redundancy, organizational self-organization and institutional learning.

Overall, the research on resilient cities is mostly from macro perspective at present, meaning that the researches focus on specific place are scarce.

2.2 Research on both resilience city and social capital

For social capital, there were a large number of related literatures which have already been published (Figure 2). However, when it comes to social capital with resilience city, only a few scholars have done relevant researches (Figure 3).

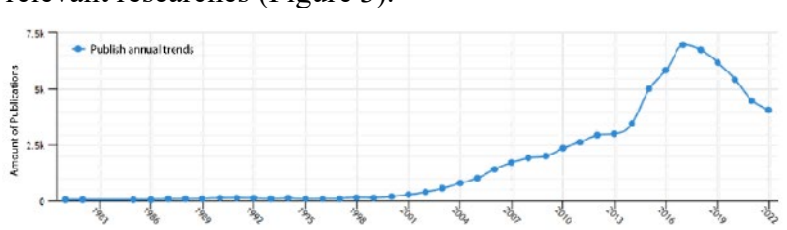


Figure 2. Trends in the number of published dissertations with "social capital " as the theme or key word (Source: CNKI database)

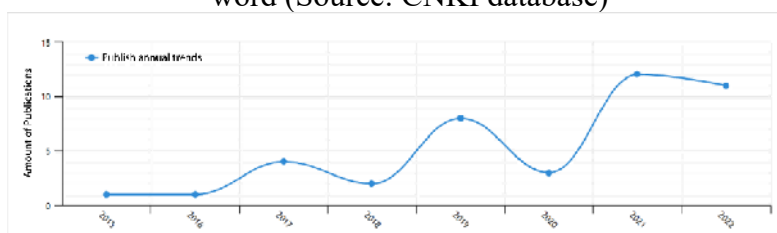


Figure 3. Trends in the number of published dissertations with "social capital and resilience city/resilience city and social capital " as the theme or key word (Source: CNKI database)

Tanglin Ye et al explore the effect on the economic resilience of city agglomeration based on spatial proximity formation of social capital and industrial associations of social capital. The result showed that different types of social capital play a different role in space scales [4]. There are also scholars who have studied the social capital from the perspective of individuals [12] and studied the impact of social capital in social spaces like enterprises and industrial association.

In conclusion, influence by national policies, resilience city theory has gradually been used in urban planning and construction fields. However, affected by COVID-19, the interact between the public plunge sharply. Social capital, as a theory which has already been proved that it is conducive

to economic development, residents' physical and mental health, healthy behavior, and living satisfaction etc. has still not been connected with resilience city theory [13, 14]. Therefore, the aim of this article is to explore the resilient evaluation method in micro scale based on social capital theory. In order to make assessment on the economic and social resilience of local district.

3. Methods

According to the relevant references, social capital should be analyzed from the following three aspects including enterprises-enterprises, enterprises-individuals, individuals-individuals.

3.1 Enterprises - enterprises

First of all, the correlation between enterprises is important. Through the concept of "industrial cluster", it can be known that the spatial aggregation of enterprises helps each enterprises improve their competitiveness, which plays an important role in the development of specific industries and the enhancement of cooperation among enterprises. That is to say, the more industries are located in concentrated areas, the more social capital they will get. Therefore, a region under this situation is more likely to strengthen the sound development between enterprises.

To ascertain this section, data of enterprises location is crawled for analysing the aggregation effect between each enterprise utilizing kernel density tool in ArcGIS.

3.2 Enterprises - individuals

The second assessment is the relationship between individuals and enterprises. For the enterprise which want to operate normally, the abundant patronage is also an essential factor representing market requirement. For instance, affected by the COVID-19, the population in commercial complex is restricted strictly, leading the majority of enterprises especially catering enterprise to go to bankrupt, so enterprises that is situated in high customer flow area are more likely to obtain high social capital, which is beneficial to the improvement of resilience.

In this section, the daily average population heat graph is able to reflect the intensity of individuals activities, which can be overlayed on the map of enterprises distribution to figure out enterprises that are apt to have more customer's flow.

The enterprises or related industries with high social capital exist strong resilience level in the face of various kind of nature or social disasters, in that they have abundant resources to rely on. However, for those enterprises, which have low social capital, are more likely to be affected by disasters meaning that those enterprises are more vulnerable which need to be focused on in future urban planning.

3.3 Individuals - individuals

The third point, which is also more complicated than other two, is the relationship between individuals. During the process of urban expansion and suburbanization, residents' social interaction and social participation are constantly decreasing, which leads to the general drop of social capital. Different from the other two that motioned-above, social capital among individuals – individuals are more dependent on day-to-day neighborhood interact of dwellers, which is more likely to reflect social relations, trust and mutual values between people, rather than the influence of policies or institution. The distance of space is also one of the most important factors of social networks and social communication opportunities. The closer the distance, the more opportunities for people to interact and communicate with each other, which is conducive to the improvement of social capital and vice versa.

Communities and public spaces are fundamental places for the public developing relationship and communicating among neighbors. As a result, how to improve the living environment and residents' living satisfaction through enhancing residents' communication and increasing community social capital is the key point. The social capital between individuals is reflected in the cohesion of the

community, meaning that a community where people know each other well must have higher cohesion than a community where residents are unacquainted to each other. That is to say, when social or natural disasters occur, the former is able to gain higher resilience through high cohesion.

3.4 Site introduction

Because of the commercial prosperity since ancient times, Dongsì district is one of the earliest commercial and business development areas in Beijing. It is also the location of the first batch of department stores in Beijing, with many small enterprises and commercial facilities.



Figure 4. Location of Dongsì district

Up to now, the format of the Dongsì district is approaching to single and aging, which requires more industrial renewal and transformation. Many old state-owned commercial facilities and enterprises have declined as a result of the rise of Beijing's new business district, which leads to the low attraction to a new generation of consumers, meaning that there is less people who still show interest in these malls and enterprises. Under the situation of lacking popularity, the investment of capital is also deficient, making a lot of enterprises and shops, which include long-established shops and enterprises, confront with the Bankruptcy risk.

Therefore, the assessment of Dongsì district not only can prevent various kinds of shops and enterprises from facing bankruptcy and extinction, but also provide advisory opinions for the future renovation. The following will analyse the social capital of enterprises and community based on the research methodology that mentioned above.

3.4.1 Population situation

The permanent resident population in Dongsì district is about 33670 in 2022. Through field investigation, it can be found that people over 60 who have already retired are account for the largest proportion (about 59%), indicating that the aging problem in Dongi district is severe (Figure 5).

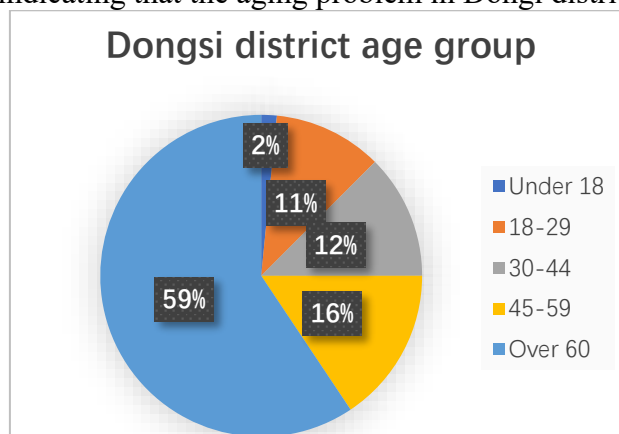


Figure 5. Age group in Dongsì district

3.4.2 Enterprises situation

In 2022, there are totally 147 enterprises situated in Dongsì district. It can be divided into four broad categories: financial insurances (a total of 13), living service facilities (a total of 15), companies (a total of 65), and catering industries (a total of 50).

3.4.3 Public spaces situation

For public spaces, no park or square can be found in Dongsì district, but there are four attractions: Prince Fu's Mansion, Dongsì historic museum, Chong Li residence and Ye Shengtao former residence. However, Chong Li residence does not open to the public.

4. Analysis results

4.1 Results of enterprises – enterprises

The four figures following show the distribution of various types of enterprises in and around Dongsì district.

The figure 6 is the distribution and density of financial insurances in Dongsì district. As can be seen from the graph, financial insurances in Dongsì district are generally gathered in the crossroads of Dongsìshitiao street and Chaoyangmen north street. There are only a few financial insurances located in the other street or inside the site, which expounds financial insurances located in the crossroads are more likely to develop the relationship of cooperation and competition. So those financial insurances have more social capital and more resilient than other financial insurances.

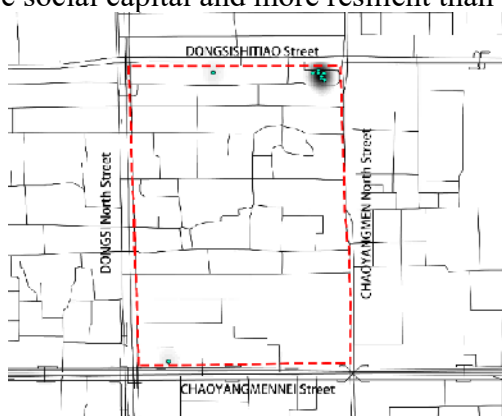


Figure 6. The distribution and density of financial insurances

Figure 7 shows the distribution and density of living service facilities in Dongsì district. It can be seen that most living service facilities are distributed independently in general, but the intersection of Chaoyangmen Street and Dongsì North Street and Chaoyangmen North Street are concentrated relatively more living service facilities. As a result, it is unfavorable for the coordination between living service departments.

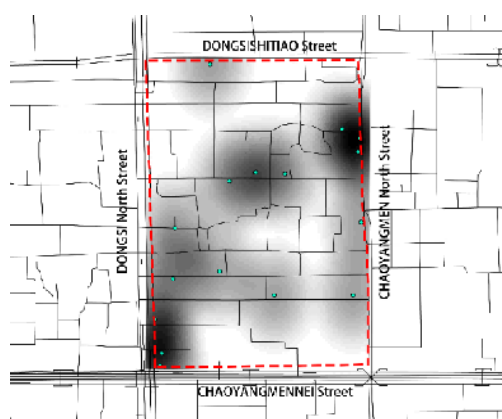


Figure 7. The distribution and density of living service facilities

Figure 8 shows the distribution and density of companies in Dongsidistrict. It can be seen from the graph that most of companies are assembling in Dongsishitiao street and Chaoyangmennei street especially in the intersection of Dongsishitiao street and Chaoyangmen north street which is similar to financial insurances. However, companies inside the site are more disperse, which have a low connection between each other.

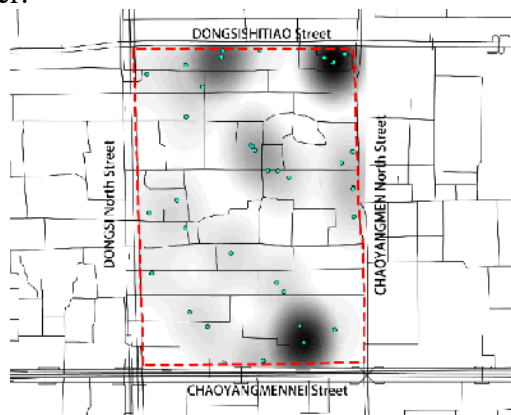


Figure 8. The distribution and density of companies

Figure 9 reflects the distribution and density of catering industries in Dongsidistrict. In terms of the graph, quite a few restaurants and food retails are mainly concentrated in the Chaoyangmen North Street. In Dongsidistrict north street and Dongsishitiao street, there are also some restaurants and food retails distributed in, which is in a sharp contrast with Chaoyangmennei street, where there are only four restaurants, exposing the vulnerability of catering industries in this street. Inside the site, restaurants and food retails located in Dongsidistrict number 6 alley are relatively dense, but that of others are exposed in low resilience.

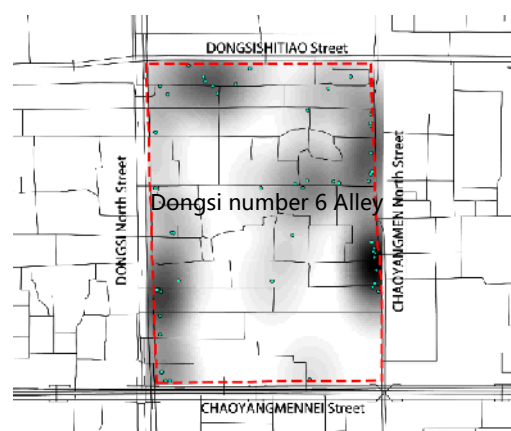


Figure 9. The distribution and density of catering industries

On the whole, as shown in figure 10, enterprises in the Dongsidistrict mostly are concentrated in Chaoyangmen north street and Dongsishitiao street especially in the intersection of two roads. The concentration of enterprises in the other two streets is relatively low compared with Chaoyangmen north street and Dongsishitiao street. Inside the Dongsidistrict, enterprises distribution is more fragmented except Dongsidistrict number 6 Alley. So those enterprises that are more disperse obtain less social capital and have lower resilience than those concentrated enterprises showing in figure 10. As a result, the disperse enterprises are more likely to be affected by disasters, which need to be care about in the future planning.

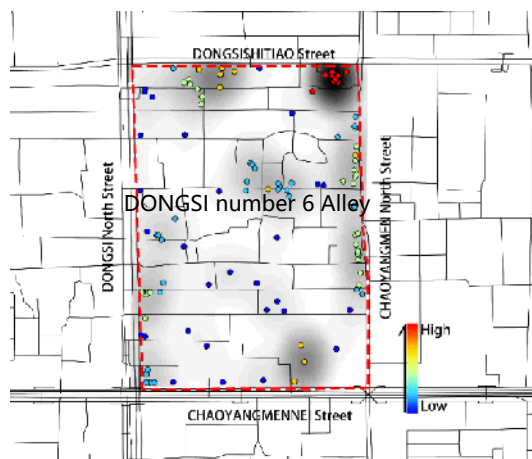


Figure 10. Resilient assessment of enterprises

4.2 Results of enterprises – individuals

If enterprises want to operate normally, abundant flow of customers are required to make enough profit to enterprises, which means that enterprises situated in a district with high population density have a higher opportunity to obtain more social capital than others. In other words, when confronted with all kinds of disasters, those enterprises is not capable of being affected on account of their high resilience. Four figure below will be overlaid on a daily average population heat diagram (figure 11) to show the information about enterprises located in crowded areas.

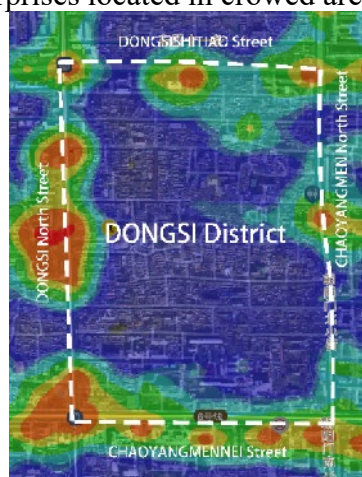


Figure 11. Daily average population heat graph

Figure 12 shows the distribution of financial insurances located in population heat areas. Compared with the financial insurances distribution map, it can be seen that all of the financial insurances are in the heat range, but only two of them are in the high population range, gaining relatively higher social capital than others.

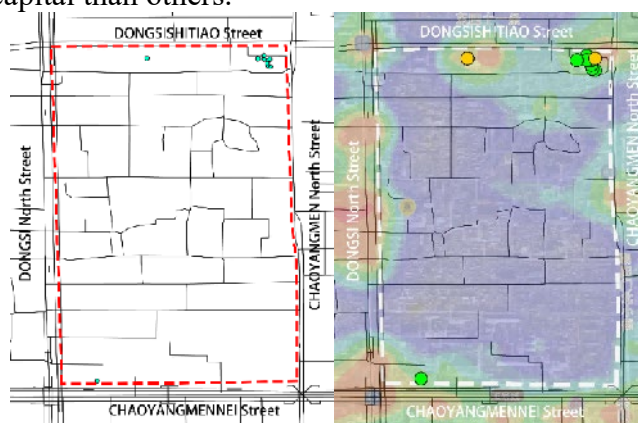


Figure 12. Financial insurances in population heat range

Figure 13 shows the distribution of living service facilities located in population heat areas. As can be seen from the graph, majority of living service facilities are not in heat range, especially those located inside the site. There, however, are also only two living service facilities situated in high population areas, which are hairdressing salon and watch maintenance shop respectively, located in the intersection of Dongsi north street and Chaoyangmennei street with high social capital. Other living service facilities, are all in a position with a low social capital.

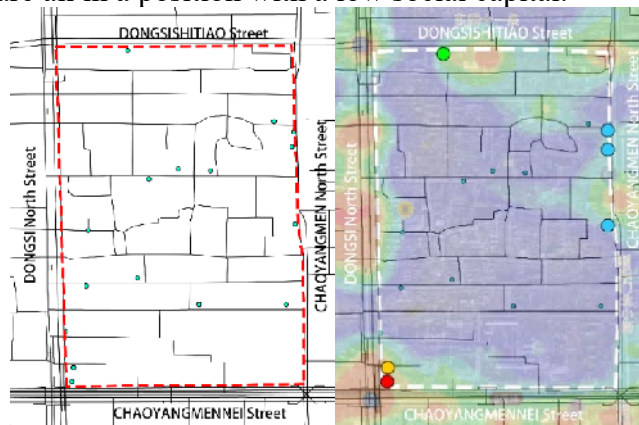


Figure 13. Living service facilities in population heat range

Figure 14 describes the companies in population heat areas. Compared with living service facilities, nearly a third of the companies are in the population heat zone, but there are less companies situated in high population areas, which are only five companies having high social capital.

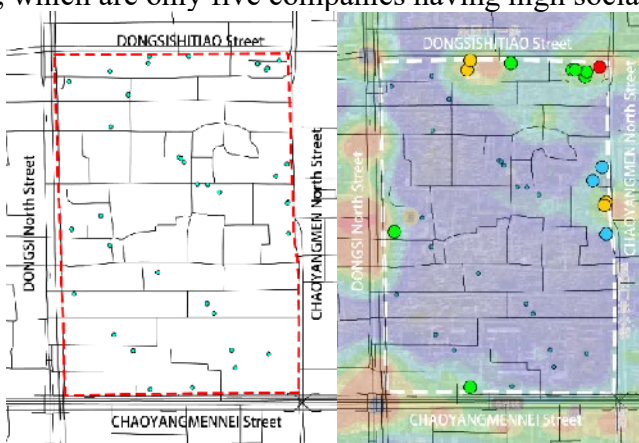


Figure 14. Companies in population heat range

Figure 15 reflects the catering industries in population heat areas. Similar with the situation of companies, there are also small part of restaurants and food retails in the population heat range, yet those catering industries which are farther form the main road especially can not obtain adequate resource of customers. So these catering industries may affect by disasters due to the low social capital and resilience.

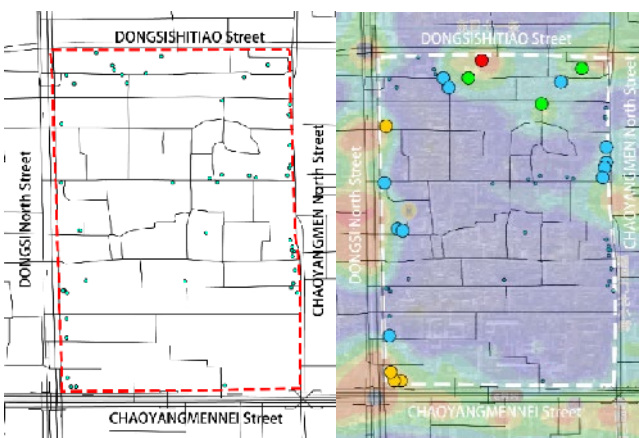


Figure 15. Companies in population heat range

In general, due to the distribution of population heat range, the overwhelming majority of enterprises that have high resources of customers are near the main roads. In other words, enterprises situated in the middle of the site are not capable of getting sufficient social capital, so those enterprises need to be focus on in future planning on account of the low resilience faced to disasters (figure 16).

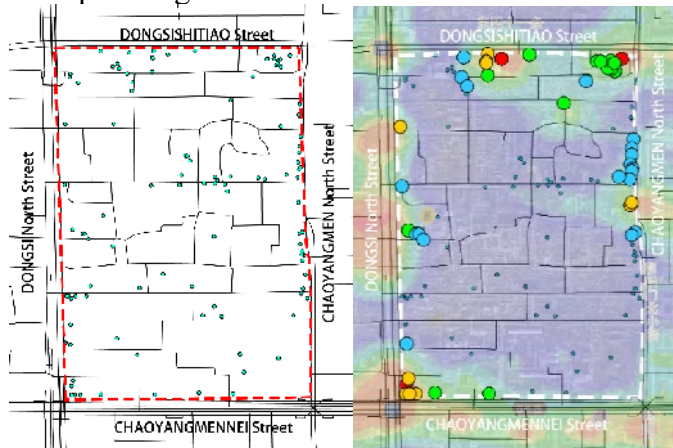


Figure 16. Enterprises in population heat range altogether

Besides, if the social capital of enterprises – enterprises and enterprises – individuals can be researched together, it is clear that there are some enterprises (emphasized in blue points) which have neither spatial aggregation nor high customers flow (figure 17 right). So those enterprises will be more vulnerable when they confronted with disasters like COVID-19 because of the lack of social capital.

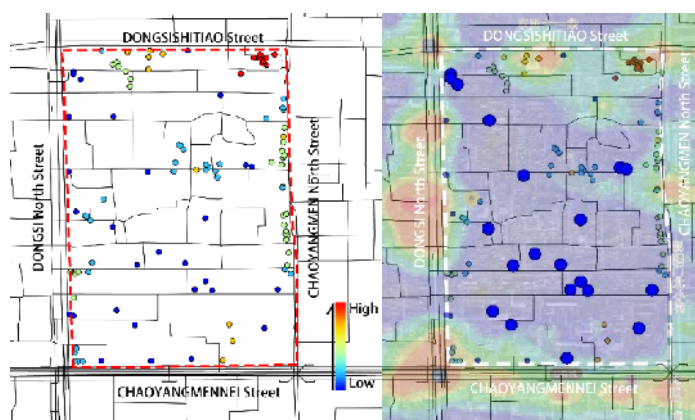


Figure 17. Enterprises have neither spatial aggregation nor high customer's flow

4.3 Result of individuals – individuals

The social capital between individuals can be measured by various factors, such as commuting time, work place, the amount of public spaces, the attractiveness of public spaces and community activities etc. [5]. Shorter commute time and closer work location are the base of social capital, and good public spaces system can increase the social capital between individuals. The following will analyse the result from commuting and public spaces.

Firstly, through the research done by Chunjiang Li and his teammates, it can be found that commuting time and working distance are inversely proportional to community cohesion. However, according to the population age group, the major residents living in Dongsishi district are over 60, so most of them have retired. Hence, dwellers live in Dongsishi district spend most of their time in the community. From this perspective, there is a good foundation of cohesion and social capital between residents.

Secondly, spatial distance is one of the most important factors affecting social network structure and social communication opportunities. As can be seen from the figure 18, the site is mainly

composed of dense residential buildings, and public space is extremely scarce. There are four attractions in the site, but few people are attracted by those places due to the low level of heat around those attractions (Figure 19). As a result of the deficiency and the poor appeal of public spaces, residents living in Dongsi district are more prone to be unfamiliar with each other, which will pose a threat to the accumulation of social capital although the foundation of social capital is good. Therefore, in the future urban planning and design, we should improve the quality of public spaces to trigger more communication happening among dwellers. In this case can the resilience of Dongsi district be strengthened.

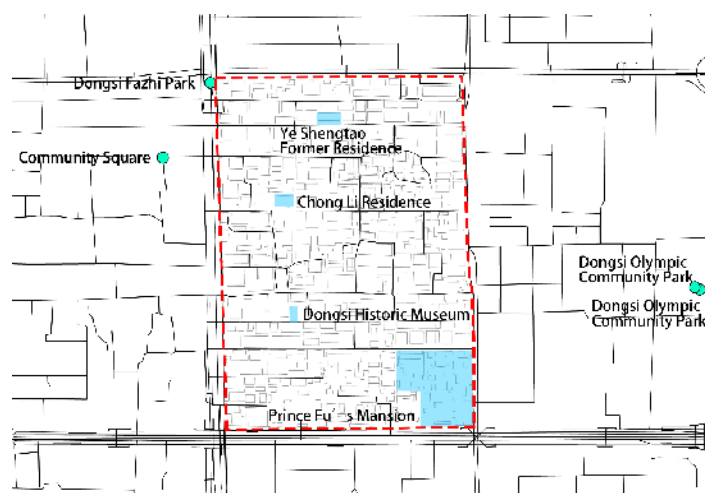


Figure 18. Distribution of public space

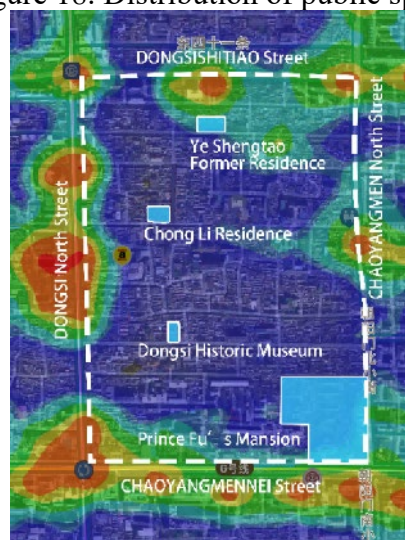


Figure 19. Attractions in population heat range

5. Conclusion

Dongsi district is a conventional commercial and business area which, however, has gradually lost its attraction to the public due to natural disasters, the development of new business district and the low vitality inside Dongsi district. The results show that compared with enterprises that in the center of the site, those near the streets particularly Dongsishitiao street and Chaoyangmen North street are prone to obtain higher social capital to raise their resilience. Besides, the public space in Dongsi district is inordinately low and four attractions are not capable of attracting people. Hence, the location of those low resilience enterprises needs to be reconsidered and high-quality public spaces and attractions are also required for cohesion of Dongsi community.

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