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This international journal attempts to provide insights into the achievement of a sustainable urban form, through spatial planning and implementation; here, we focus on planning experiences at the levels of local cities and some metropolitan areas in the world, particularly in Asian countries. Submissions are expected from multidisciplinary viewpoints encompassing land-use patterns, housing development, transportation, green design, and agricultural and ecological systems.

International Review for Spatial Planning
and
Sustainable Development

Content

Editorial Introduction
Special Issue on "Sustainable Residential Areas"

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As cities change and evolve over time their adaptive capacity is regularly questioned. Cities can be vulnerable to the effects of population change, climate change and the pressures of modernisation and globalisation, or they can be designed and built with those effects and the capability to manage them, even benefit from them, in mind. Designing, creating and managing sustainable residential areas, those that last the test of time, is pivotal to providing liveable environments for residents. Sustainable residential areas provide adequate and secure housing, prosperous social and cultural environments, and ensure a well-educated, healthy and motivated workforce for local economies. In addition, as inhabitants are recognised for their diversity and are engaged in their living environments, public participation in urban planning is an essential step in the process of sustainable urban design. This special issue thus brings together urban planning research focusing on three key areas: the use and access of information technology to residents, residential area uses and divisions, and urban area renewal.

The first paper, by authors Anrong et al. (2016), focuses on smart community planning, exploring an approach for creating and promoting an information-sharing platform in Yishanwan, Jiangxia Distict, Wuhan, China. The framework consists of a base layer, sharing layer, application layer, service layer and portal layer with an implementation target of achieving a newly created smart community supporting improved and ongoing public participation.

This paper is followed by the research of Chang et al. (2016) who analyse the geography of the digital divide on a micro-scale in Nanjing, China. The research provides an index system based on cluster and regression analysis utilising survey data about personal internet usage patterns. The analysis finds that individual socio-economic attributes, as well as the location and housing of residents, has a significant impact on internet usage patterns. This finding may contribute to the planning of civil engagement as well as emphasize differing community educational requirements regarding smart, digital planning solutions.

Zhang et al. (2016) conducted research on the spatial and temporal patterns of residents' daily activities through the collection of GPS data by survey. The research found different patterns of movement for different activities as well as for differing times and days of the week. The study was based in Beijing, China, and found that despite the urbanisation of Beijing's residential areas, some are still lacking in job opportunities and shopping

facilities. The analysis of GPS data in this study demonstrates an effective method of identifying the needs of communities and providing information for future residential area planning.

The fourth paper of this issue, by Bi and Zhang (2016), looks at the influencing factors and policy distortions of school zoning areas in central Beijing using GIS mapping, survey and interview methods. The study identifies a contradiction within the Chinese public school enrolment system, where students may or may not be actually residing within the designated school zones and discusses the legitimacy underlying the current enrolment system. The findings of this research may be applied to the zoning of school districts, as well as the development of educational policies that address the requirements of modern urban families to create more sustainable communities.

Chiranthanin and Suzuki (2016) consider the concept of 'neighbourhood' in the context of Nimmanhaemin District, Chiang Mai, Thailand, where traditional residential areas are being increasingly encroached upon by commercial enterprises. The research uses community participation and questionnaire data to identify methods for urban management, including managing traffic flows, zoning, city image promotion and community design, in order to connect and consolidate residential areas and public spaces, while accommodating and promoting the unique industries and economic opportunities of each area within the district. This research provides strategies to create neighbourhood networks that operate within modern commercial areas where traditional zoning rules may no longer be applicable or sustainable.

Yang and Lanchun (2016) likewise research the long-term sustainability of traditional residential areas, looking in particular at the renewal of traditional residential social/public spaces in Shichahai, Xisibei and Nanluoguxiang, Beijing, namely typical courtyard spaces. The study conducts an investigation and quantitative analysis of the living spaces and social and economic problems of residents surrounding each courtyard and explores strategies for the improvement of public spaces within residential areas from the perspectives of physical space and public policy.

Looking specifically at individual buildings, Suling et al. (2016) explore a method for efficiently and intuitively protecting traditional buildings, including a Qing dynasty tea house in Guifeng Village, China. The research method uses a Building Information Model to collate, process and save building data which can then be used to create 3D virtual models utilising Revit Architecture software. This research demonstrates the virtual remodelling of traditional buildings within their existing contexts and provides a new method contributing to their protection and renewal

The final paper of this issue, by Huang et al. (2016), identifies the need for a method of assessing the performance of the many urban renewal projects in Taipei City, Taiwan. Taipei City faces many typical problems of rapid urbanisation, including traffic congestion, a lack of public facilities and deteriorating environmental quality. This study categorises urban renewal projects by considering their environmental, economic and social impacts, then utilising a Data Envelopment Analysis method to evaluate the overall efficiency of each project. This study provides a method of evaluation that may be employed by government agencies or developers in order to propose efficient urban renewal projects for ensuring effective investment in future, sustainable project designs.

This special issue on sustainable residential design is an outcome of the annual Workshop on Urban Planning and Management in Kanazawa, Japan,

held February 27th to March 1st 2015. Sincere thanks goes to all organisers and both local and international participants of the event, particularly to the Urban Planning Laboratory of Kanazawa University for their hosting of the workshop. I would personally like to thank all authors and reviewers for their efforts invested in their research, submissions and throughout the publication process. I hope the body of research presented in this special issue may continue to thrive through further study and prove useful as reference material for urban design academics, planners and policy-makers alike.

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Analysis of spatial and temporal patterns of daily activities of suburban residents based on GPS data: A case study of the Shangdi-Qinghe area of Beijing

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Abstract: The rapid growth of urban populations in China, together with dramatic institutional transition, has led to the fast spread of urban space and a growing tendency toward residential suburbanization. Remarkable environmental changes have taken place in urban China, with large suburban residential areas emerging in big Chinese cities. As often observed in urban China, the dwelling environment of suburban areas is distinct from downtown areas with less job opportunities and insufficient facilities, resulting in longer distance in daily trips and disadvantages in residents′ accessibility. This study, based on a GPS-based activity-travel survey in Beijing in 2012, applies a time-geographic research framework to explore the activity pattern of suburban residents in both spatial and temporal dimensions as an attempt to reveal characteristics of suburban China. Emphasis is put on daily rhythms and time allocation of activities based on the activity-travel diaries and time space paths based on the GPS data. On the one hand, in the aspect of time, it is observed that the daily life of the suburban residents tends to be regular on weekdays, diversified and fragmented on weekends. On weekdays, working activities constitute a dominant part in time allocation, while on weekends, housework and leisure activities constitute a greater part of time use. On the other hand, in the aspect of space, it is found that the majority of the suburban residents are employed in the inner city and most of the non-work activities take place in suburbs with an exception of shopping activities on weekends. Travel on weekdays is "less time and multi-purpose" and on weekends is "multiple time and single-purpose". It could be concluded that the suburban areas in Beijing, while being gradually shifting from dwelling space to living space for suburban residents, still need further promotion in job opportunities and shopping facilities. The results from the study shed light on the weekly spatial and temporal patterns of suburban residents in China and provide beneficial implications for spatial planning and infrastructure construction in the suburban areas to enhance the quality of life in suburban China.

1.   INTRODUCTION

Since suburbanization appeared in the 1920s in western countries, it set off a wave of suburbanization in developing countries and the impact of suburbanization has penetrated deep into people′s everyday activities. This is a new phenomenon after World War II as an important result of highly developed urbanization. The process of suburbanization has not only

reshaped the internal spatial structure of the city, forming a unique suburban built environment and landscape, but also promoted the reconstruction of the residents' lifestyles and activity space (Zhang and Chai, 2011). Suburbs are the result of urban space evolution and also the product of residents' perceptions. It is a carrier of human daily activities and people's various life activities contributed to the further development of suburban refactoring (Clapson, 2003). Fava (1956) carried out a summary of the properties of the suburbs in the United States. She considered that suburban areas actually represent a way of life. So suburbanization is a hot topic in urban research and planning, in particular, real-life case studies of suburban residents gained extensive attention in the world. For example, studies have indicated that in America, population and industry suburbanization and social segregation have caused "spatial mismatch" between the residential places and the working places. This has led to ethnic groups and low-income groups in the central city being faced with declining employment accessibility, increasing unemployment rates and other austere challenges (Kain, 1992; Preston, et al., 1999). The phenomenon that white married women in American suburbs faced up to reduce employment is called the "Space Trap" (England, 1993; Rapino, et al., 2011). In the United States and Japan, suburban married women with children often choose part-time work in the suburbs or even give up jobs due to time and space constraints as they cannot balance home care activities and long commuting distances (Kwan, 1999). In Japan, the suburban space of the big cities is the space of married women with children in the day because most men need to bear the long-distance commuting to go to the center city. Thus it forms a relatively fragmented activity space including housing in the suburbs and work places in the downtown (Okamoto, 1997). Behrens took a two day activity diary survey to study the travel pattern in the inner city and the suburbs in Cape Town. He discovered that residents travelled around eight times a day and about 30% of that was on foot. The travel numbers increased significantly after the suburban family bought a car, but in the inner city, the travel rate of families with cars and without cars are the same because in the inner city there is a high density of facilities so that people can complete activities smoothly (Behrens, 2002). Some studies take "the resident location" as a binary variable, analyzing the aiciticity characteristics between the inner city and the suburb（Schwanen, et al.,2002; Bromley, et al.,2003Schwanen et al., 2002；Bromley et al., 2003）.

Although in recent years some suburban areas of big cities continue to develop into relatively comprehensive "suburban cores" or "suburb centers", with many localized large retail facilities and employment opportunities evolving, the living space of the suburbanites presents a localization trend, but the suburban living space and lifestyle is not the "suburb dream" as portrayed by early suburbanization (Zhang and Chai, 2011). The interaction between physical urban space in the suburbs and the human behavior needs to be reflected upon and city planners need to rethink suburban planning from a micro perspective of the residents' needs.

In China, suburbanization is constantly evolving. Since the beginning of the 1980s, the policy of reform and opening up of the Chinese economy, the society and urbanization developed rapidly. As the capital city of China, Beijing constantly improves the progress of urbanization and urban functions have continued to be improved upon. With the rapid expansion of the urban population, the city has been expanding. As a result, a lack of land for urban development, traffic congestion, environmental pollution and other pressures have evolved. Under these pressures, the government has carried

out a series of policy reforms of the land use system, built highways, real property development, industrial structure adjustment and so on. During 1982 to 1990, Beijing entered the process of suburbanization (Zhou, 1996), however, the suburbanization of Beijing is different from in Western countries. The suburbs are still controlled by the central city, and the employment and facilities in suburbs has greatly lagged behind the pace of the development of housing, thus leading to the spread of urban spheres, post living dislocation, traffic congestion and a series of other problems (Song, 2007).The need to improve the quality of life is pressing. Residents living in suburbs desire a compact, efficient and convenient living space and their demands are increasingly strong. The living space in suburbs needs to be remodelled.

At the same time, China's economic and social development is facing a comprehensive restructuring. There are some changes in the paradigm of urban planning and management in China: from land-use based urban planning to individual based planning, turning to focus on optimization and adjustment, not large-scale new construction; from stable blue-print planning to dynamic and process-based management, the focus has been much on behavioural space, rather than physical and functional space. As a result, people-oriented urban planning has become the core issue of urban development. Quality of life and quality of urbanization is emphasized and application of space-time behavior research in urban planning and urban management has become increasingly important. In this context, space time behavior analysis of the residents has attracted tremendous attentions, but such research is still relatively undeveloped in China.

This study based on a GPS-based activity-travel survey in Beijing in 2012, applies a time-geographic research framework to explore the activity pattern of suburban residents in both spatial and temporal dimensions as an attempt to reveal the characteristics of suburban China. From the microscopic perspective, to analyze the problems of suburbanization development in Beijing, beneficial implications for spatial planning and infrastructure construction in the suburban areas can be provided addressing the quality of life in suburban China.

2.   DATABASE AND THE CASE AREA

2.1   The case area

The case area is the Shangdi-Qinghe area in the middle-east part of Haidian District, between the North Fifth Ring and the North Sixth Ring of Beijing (*Figure 1*). Its total area is about 16 kilometers. It is crossed by an expressway and a light railway which connect it with another residential area in the north (the Huilongguan area) and an employment center to the south of the area (Zhongguancun Science Park), as well as the central city of Beijing. The resident population is about 24 million and the employment population is about 14 million. This area sporadically developed before 1949. Between the 1950s and 1970s, planned economy and industrialization promotion and productivity layout land expansion of industrial production in the region and the urban population increased, but the entire region's land use is still mainly agricultural land. In the 1980s, along with rapid urbanization and dramatic transformation of the market, the region's rapid urban population growth and rapid reconstruction of urban space, the urban

population and the urban landscape have gradually replaced the rural population and rural landscape, forming a coexisting pattern of the traditional industries, new industries and large residential communities. Despite the mixed land use, most housing in the area is unaffordable for the workers here and a large proportion of residents living in this area work in other areas of Beijing, which has led to a severe jobs-housing spatial mismatch. It can be said that the Shangdi-Qinghe area is a typical suburb area in the context of China's rapid suburbanization.

Figure 1. The location of Shangdi-Qinghe district in Beijing

2.2   Database

This study based on a GPS-based activity-travel survey in Beijing in 2012 was taken by the space-time behaviour group of Peking University in Beijing. The investigation was conducted in the Beijing Shangdi-Qinghe district, excluding villages and military compounds, it included 23 communities. The survey used GPS trackers (*Figure 2*), a survey website and interviews with participants to collect the data (Figure 3). Specifically, the GPS trackers were used to collect the tracking data and the survey website was applied to collect the activity-travel diary data and socio-demographic information of the participants. Both the GPS tracking data and activity-travel diary data were collected for a 7-day survey period. After the survey, the GPS tracking data were matched to the activity-travel diaries to create a GPS-based travel diary dataset. In the survey we provided a GPS tracker to each participant. The tracker is approximately the size of a cell phone and participants could carry the tracker at any time. The tracker logged the space-time coordinates of each participant every two minutes. It was powered by a built-in battery, which needed to be charged every day. A survey website was developed and used for collecting the activity-travel diary data and socio-demographic information. We provided each participant with a username and password to log in on the website and fill in the requested information. The website includes an interactive activity-travel diary interface for participants to fill out, a socio-demographic questionnaire interface for participants and a monitoring interface for survey administrators (Chai, et al.,2014). Ultimately, the effective sample was 480 and the effective sampling rate was 89.63%.
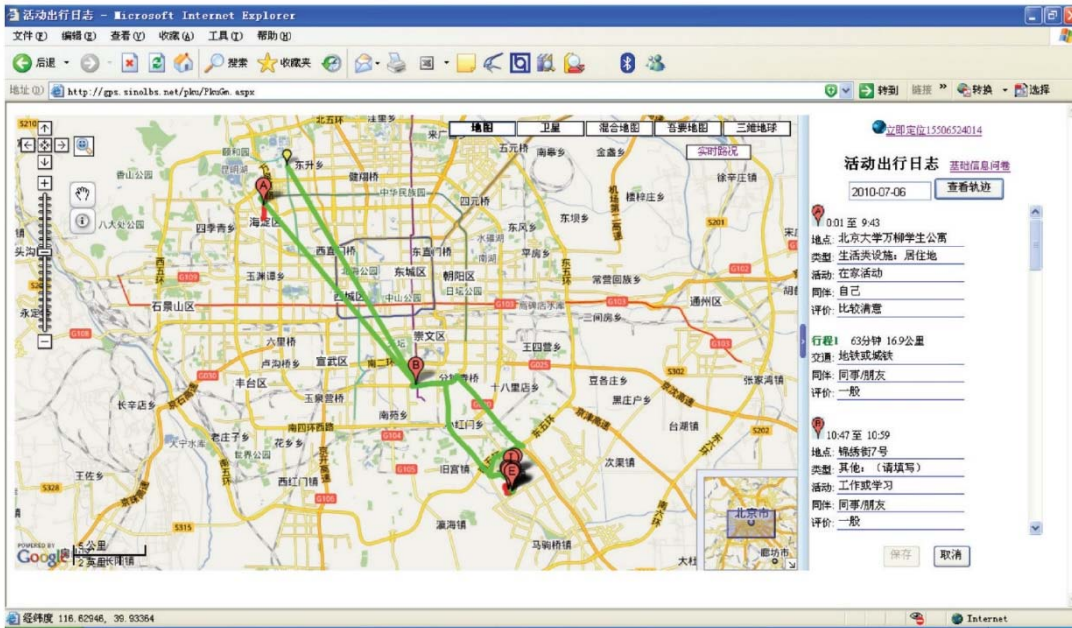
Figure 2. Activity and travel information filling interface for respondents

Figure 3. The GPS tracker used in the survey

2.3   Sample attribute analysis

Socio-economic attributes of the sample statistics are shown in *Table 1*. The sex ratio of the survey sample is relatively balanced. 64.3% of the residents are under 40 years old. 89.4% of the individuals have Beijing registered permanent residence. 50.2% of the individuals have young children. 49.6% of the individuals have a college degree or above. In terms of employment, the highest proportion was for company employees. 58.5% of the individuals' monthly incomes are 4,000 yuan or below. 46.5% of the individuals have a driver's license.

Table 1. Socioeconomic characteristics of the samples

	Sample(N=480)
Gender	
female	52.3%
male	47.7%
Age	
10～19	0.8%
20～29	17.5%
30～39	46.0%

40～49	22.9%
50～59	11.9%
>60	0.8%
Place of domicile	
Beijing	89.4%
Have young children	50.2%
Education	
high school or below	20.9%
junior college	29.6%
undergraduate college	33.3%
graduate or above	16.3%
Employment status	
worker	5.0%
public servants	18.3%
company employee	44.2%
individual business	1.9%
service staff	14.6%
other employment	16.1%
monthly income	
<1000 RMB	5.0%
1001～2000 RMB	15.0%
2001～4000 RMB	38.5%
4001～6000 RMB	20.0%
6001～10000 RMB	12.9%
>10001 RMB	8.6%
Driving license	46.5%

3.   TIME RHYTHM AND TIME ALLOCATION FEATURE

3.1   The rhythm in workdays is homogenised and in weekends is diversiform

Time rhythm is viewed from the perspective of time to consider all kinds of activities people carried out. It is a way to visually recognize people`s one week time use laws. Shown in *Figure 4*, the horizontal axis represents 7 days' time (in units of minutes), while the vertical axis represents the proportion of the individuals, expressed as the sample proportion, that do certain events at a certain time.

From the figure it can be found that on weekdays the working activities of residents showed typical "Twin Peaks" characteristics, namely in the morning from 9:00 to 11:30 and 13:00 to 17:00 pm; on rest days, two peak working activities still exist, but the proportion significantly declines and the

peak appears between 9:30 and 11:30 and from 13:00 to 16:30. Few leisure activities take place during the day, while the proportion rises from 20:00 to 21:00 in the evening (approximately 60%). On weekends, leisure activities appeared at three peaks respectively, from 9:00 to 10:00, 15:00 to 16:00 and 20:30 to 22:00. On weekdays, domestic activities have remained below 13% of the proportion, mainly in the morning between 6:30 to 9:00, and from 17:00 the proportion gradually increased. Around 20:30 it peaks. On a Friday night, domestic activities continue for a relatively long time, until around 21:30. On weekends, the proportion of the activities significantly increased. From 8:30 to 11:00 it begins to peak (30%). From 14:00 to 22:00, domestic activities gradually ended. Shopping activities on weekdays is very fragmented and remains below 5% of the samples, while on weekends shopping activities are significantly increased and there are two peaks respectively, from 10:00 to 11:00 and 14:00 to 16:00. In addition, the travel peak on weekdays is from 6:30 to 8:00 in the morning, declining from 9:30; the peak in the evening is from 16:30 to 18:00 and continues until 20:00. On weekends, the travel peak occurs at about 10:00, but the peak is significantly lower than on weekdays.

Overall, residents′ time schedules on weekdays are centered on work activities, followed by sleep-work-lunch-work-shopping, housework, meals, recreation, etc. The time schedules on weekends are around housework, leisure and other activities, followed by sleep-housework, leisure, shopping-lunch-housework, leisure, shopping-sleep. The rhythm on workdays is homogenised, and on weekends is diversiform.
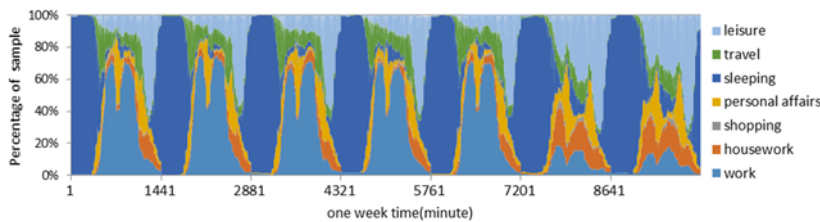
Figure 4. The weekly activity patterns of the female residents in the study area

3.2   The time allocation of non-work activities increased significantly on weekends compared with workdays

The results showed that there are significant differences in distribution between workdays and weekends in the time of work, housework, personal affairs, sleep and leisure activities (

		work	housework	shopping	personal affairs	sleeping	travel	leisure
Duration（hour）	Mo	6.19	1.46	0.12	2.13	9.14	1.97	2.97
	Tue	6.45	1.42	0.08	2.11	9.06	2.12	2.74
	We	6.20	1.41	0.08	2.23	9.17	2.15	2.81
	Thu	6.29	1.23	0.14	2.06	9.18	2.15	2.93
	Fri	6.25	1.49	0.16	2.10	9.06	2.16	2.79
	Sat	1.63	2.69	0.30	2.37	10.28	1.54	5.17
	Sun	1.51	2.72	0.25	2.40	10.46	1.34	5.30
ANOVA	F	121.03	82.436	2.369	9.816	235.904	1.147	340.466

between weekdays								
and weekends	Sig.	0.000	0.000	0.125	0.002	0.000	0.284	0.000

). The average working hours of the suburban residents on weekdays is 6.27 hours and 1.57 hours on weekends. At the time of the survey, the distribution of household activities on weekdays averaged 1.41 hours of housework, while on weekends it is longer than 1.29 hours. The average leisure time on weekdays is about 2.85 hours and on weekends it is more than 2.39 hours. So work occupies the most significant part of their time on weekdays. This is accompanied by relatively fixed shopping, home, travel and leisure time. On weekends, the time allocated for housework and leisure are significantly increased.

Table 2. The time-use distribution of residents in the Shangdi-Qinghe district

		work	housework	shopping	personal affairs	sleeping	travel	leisure
Duration（hour）	Mo	6.19	1.46	0.12	2.13	9.14	1.97	2.97
	Tue	6.45	1.42	0.08	2.11	9.06	2.12	2.74
	We	6.20	1.41	0.08	2.23	9.17	2.15	2.81
	Thu	6.29	1.23	0.14	2.06	9.18	2.15	2.93
	Fri	6.25	1.49	0.16	2.10	9.06	2.16	2.79
	Sat	1.63	2.69	0.30	2.37	10.28	1.54	5.17
	Sun	1.51	2.72	0.25	2.40	10.46	1.34	5.30
ANOVA between weekdays and weekends	F	121.031	82.436	2.369	9.816	235.904	1.147	340.466
	Sig.	0.000	0.000	0.125	0.002	0.000	0.284	0.000

4.   MOBILITY FEATURES

4.1   Travel frequency and trip rate

Travel frequency and trip rate reflects the level of life quality to some extent. Compared to weekdays, the trip rate decreased significantly on weekends (*Figure 5*). The number of trips per day on weekends was significantly higher than on weekdays. The proportion of multi-purpose trips declined on weekends, the proportion of shopping, leisure and other non-work activities rose on weekends (*Table 3*). Overall, on weekdays, suburbanites employ "less time, multi-purpose" travel, while on weekends "multiple, single-purpose" travel.
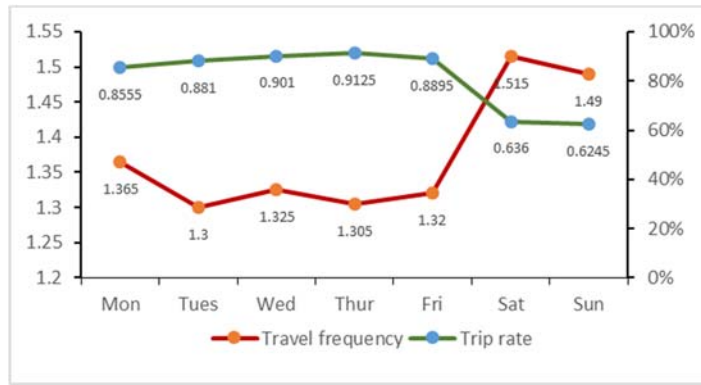
Figure 5. Travel frequency and trip rate of the samples

Table 3. The percentage of trips by purpose

	multi-purpose tour	working stop	shopping stop	leisure stop	home stop	other stop
Mon	30.9%	37.9%	2.1%	6.2%	40.5%	13.4%
Tues	30.6%	37.6%	1.9%	6.3%	40.0%	14.3%
Wed	25.6%	37.6%	2.0%	5.2%	42.5%	12.8%
Thur	29.1%	37.6%	3.6%	5.6%	40.3%	12.9%
Fri	31.7%	35.8%	2.6%	6.8%	38.8%	16.1%
Sat	20.9%	14.0%	8.4%	13.0%	42.7%	22.1%
Sun	26.4%	11.0%	8.3%	12.7%	46.0%	22.2%

4.2 The activity space significantly deepened in the inner city on weekdays

With the three-dimensional space-time GIS visualization technology based on a time and geography framework, the activity pattern of the residents was visualized. The first two dimensions represent the Beijing urban space, while the third dimension represents time, and from bottom to top, it represents 0:00 to 24:00. The trajectory in three-dimensional space constitutes the space-time path. The line which is perpendicular to the spatial plane represents the time use of different activities. The podetium represents the different geographic range of the city in order to identify the residents' dependence on internal space. It can be found that on weekdays, as many residents need to commute to the inner city, the activity space is relatively large and was deeper in the inner city. At weekends, the paths of the individuals were very different in space and time and were deeper in the space of their communities and close surroundings (*Figure 6*).

a. Space-time paths on weekdays
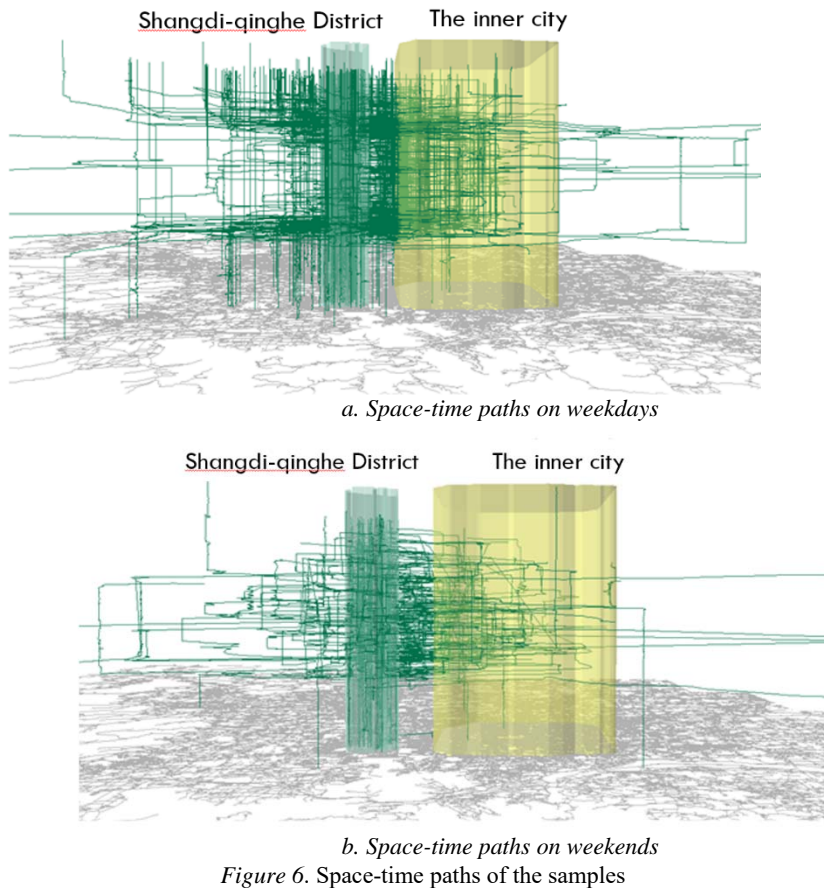
b. Space-time paths on weekends
Figure 6. Space-time paths of the samples

4.3   "Semi-localization" type of working space, "near home" type of non-work activity space on weekdays

37% of the samples` commuting distance is within 2.5 km. 70%~80% of the residents work within a 10km range. About 10% of the residents need to work more than 15km, long-distance, from home. It shows that some suburbanites choose work in the inner city and some choose it in a local space, thus formed the "Semi-localization" type of working space. On weekdays, about 70% of the shopping activities occur within the range of 2.5km away from home and about 20% of the shopping activity occurs in the range of 5~15km away from the home. Beyond 15km little shopping activity occurs. On weekends, shopping activities occur within a 2.5km range, a slight decrease, and it decreased significantly for the 5~15km range, while outside the 15km range it increased significantly. As can be seen, on weekdays, residents shop in their own neighborhood or at work places. On weekends, the residents will choose to go to more distant shopping malls. About 87% of the leisure activities occur within 2.5km from the home on weekdays and the proportion of leisure activities within a 2.5km range is slightly higher than that of the 20km distance proportion. The phenomenon of "near home" type of non-work activity space on weekdays is obvious (*Figure 7*).
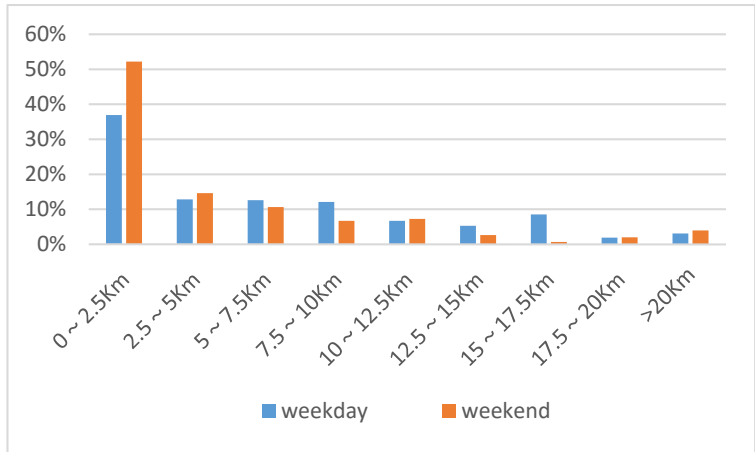
a. Trip distance of work
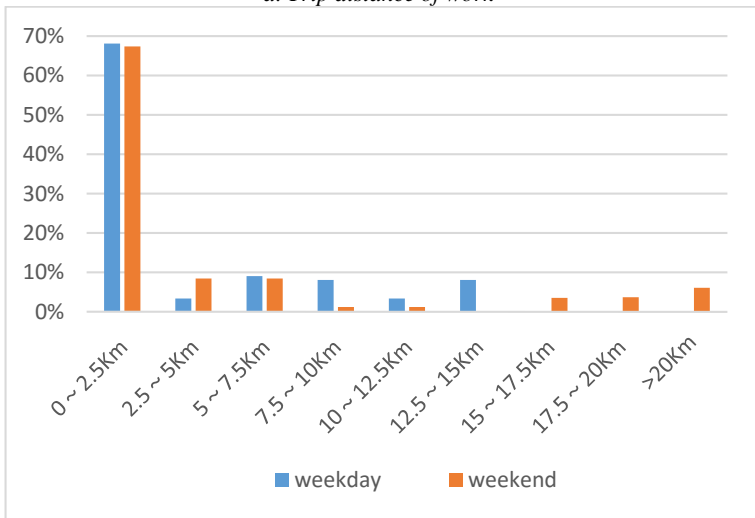
b. Trip distance of shopping
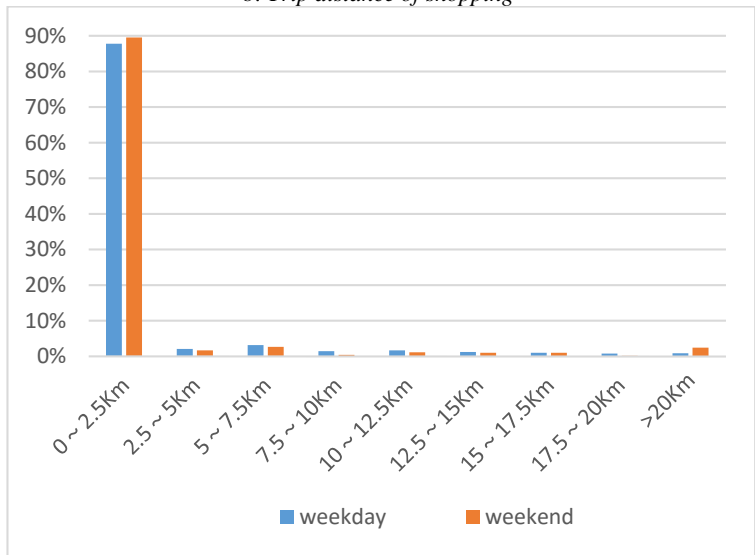
c. Trip distance of leisure activities
Figure 7. Trip distance of the activities

5.   CONCLUSIONS AND DISCUSSION

With the rapid urbanization of China, urbanization has been human-oriented. The development of suburbs has gradually shifted from production,

space-oriented to living, space-oriented, from an emphasis on land function to the quality of residents' lives. Through the analysis of suburban life time distribution and temporal characteristics of rhythm, we can explore the suburban life time planning. Through adjusting the opening hours of public facilities in the suburbs and the time schedule of the residents, urban planning and management can be refined and effective remedies can be found to the disadvantages in the existing urban planning system. Through the analysis of the spatial extent of suburbia, we can effectively analyze suburban living space structure and the utilization of different urban space areas as a starting point to build a suburban daily living space hierarchy. Through the analysis of the daily activities, individual behavior planning can lead to innovation of the traditional planning system, for example providing personalized travel information services for the residents.

Over all, on the one hand, in the aspect of time, it is observed that the daily life of the suburban residents tends to be regular on weekdays, diversified and fragmented on weekends. On weekdays specifically, working activities constitute a dominant part of time allocation, while on weekends, housework and leisure activities constitute a greater part of time use. On the other hand, in the aspect of space, it is found that the majority of the suburban residents are employed in the inner suburban areas and most of the non-work activities take place in the suburbs, with the exception of shopping activities on weekends. Travel on weekdays is "less time and multi-purpose", while on weekends it is "multiple time, single-purpose". It could be concluded that the suburban areas in Beijing, while gradually shifting from dwelling space to living space for suburban residents, still need further promotion in job opportunities and shopping facilities. The results from the study shed light on the weekly space-time behavior pattern of suburban residents in China and provide beneficial implications for spatial planning and infrastructure construction in the suburban areas addressing the residents′ quality of life.

In the future, we will conduct further research. The day-to-day difference of behaviour patterns will be one directional. Using the detailed bahavior analysis, we can conduct pattern recognition and analyze the spatial-temporal variability and flexibility of travel behavior and activities. By combining the behaviour data to road network data, we can analyse the travel behaviour much further and calculate the potential activity area of the suburban Chinese residents. Also, the companionship between social networks and lifestyle is another direction for research. Activity analysis based on intra-household interaction and household task allocation can be conducted and transportation research using floating car data and IC card data can be done.Individual behaviour planning based on an activity-based approach is a planning application direction. In addition, living space planning, considering individual's needs, can be focused on through physical and social space planning in communities with the aim of improving quality of life and reconstructing the lifestyles of communities. The third research direction is to influence time use planning in order to adjust the life rhythm of the city as well as affect the interactions of work and leisure, in order to build a more balanced life for individuals. Based on the above research, we want to contribute to the behavior aspect of urban transition theory in China and conduct a comparative study of suburban development between China and other countries from the perspective of behavior analysis.

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Protection and regeneration of traditional buildings based on BIM:A case study of Qing Dynasty tea house in Guifeng Village

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Abstract: In the context of China's rapid urbanization, large quantities of traditional buildings are disappearing. How to efficiently and intuitively protect these traditional buildings is an important issue being faced. Taking a Qing Dynasty tea house in Guifeng Village as an example, this paper applies information collection, processing and saving in a Building Information Model (BIM) for traditional buildings. It focuses on the application of BIM in traditional buildings' surveying and creating 3D virtual models of a tea house with Revit Architecture, in order to provide a new method for the protection and regeneration of traditional buildings.

1.   INTRODUCTION

According to "Voice of China News" reporting and the relevant departments of the latest statistics it was shown that there were 3.6 million villages 10 years ago, however now only 2.7 million, with about 80-100 villages still disappearing everyday on average, including a large number of traditional villages. At present there are 2.3 million villages, but less than 5000 traditional villages with high conservation value remain, accounting for only 1.9% of the national total administrative villages (MOHURD, 2013). Historic preservation, adaptive reuse, and sustainable urban design that considers the full range of social, environmental, and economic factors is an essential component of sustainable urban development (Lewin and Goodman, 2013). In the context of China's rapid urbanization, large quantities of traditional buildings are disappearing and their protection requires a lot of manpower and financial resources.

How to efficiently and intuitively protect these traditional buildings is an important issue. Protection in the past consisted of recording the two-dimensional information of traditional buildings with CAD, which was not easy to census and arrange. The introduction of Building Information Modeling (BIM) technology can improve the efficiency of the traditional buildings' protection and the protection work will be more scientific and justifiable. BIM is a digital representation of physical and functional characteristics of a facility. It contains geometry information, performance and function et cetera of all components in the model. All information

throughout the project life cycle is included in a single model which includes not only the components of the model itself, but also the construction schedule, the construction process and maintenance management information (Goldberg, 2004).

This paper takes a Qing Dynasty tea house in Guifeng Village as an example and creates a model with Revit Architecture to analyse the advantage in traditional buildings' protection and regeneration with BIM.

2.   LITERATURE REVIEW

BIM was introduced to China in 2003, although late, the concepts, technologies and related software have now been recognized by people in the construction industry of China. In the near future, it will replace the current mainstream to become the next generation of mainstream software systems in the construction industry (Yang, et al., 2013). During this period, many scholars have done a lot of research on the application of BIM for traditional buildings. Combining with "Xi'an residential protection project," (Wang and Xue, 2007) discussed and summarized the protection of traditional buildings in new technologies and new methods, particularly the application of three-dimensional laser scanning technology and BIM. Some advantages of applying BIM to traditional building surveying are put forward regarding the aspects of data recording, sharing data models and the data counting (Sun, et al., 2014). (Wang, et al. 2014) designed an index performance function to extract quantified ancient building information models incorporating critical information with the information reuse technology based on BIM, creating an economic evaluation index. (Zhu and Wu, 2012) selected a number of different structural forms of the early extant examples of wooden architecture as a case study to make a preliminary inquiry of information model building ideas and methods based on BIM technology, analysing BIM family planning of building elements. There are also some scholars who have analysed parameter models from Revit Architecture, the core software of BIM.(Sun and Xu, 2012) from model elements, annotation symbol entity, and viewing database elements in four areas, made an overall appearance of an ancient building information model to show, focusing on the subject of the information model, model elements. (Luo and Ji, 2009)described the elementary methods in parametric modeling of Chinese traditional architecture based on family components, including the setting of parameters, the modeling of main structures and rooves, using the case study of Cuanjian Pavilion. In addition to the application of BIM for single buildings, Li and Xia (2012) expanded the scope of a study proposed for the study of historic district City Information Modeling (CIM), to solve the shortage of existing BIM software when applied to an urban scale.

3.   PROJECT BASIC INFORMATION

3.1   Regional location

Guifeng Village is located in the northeast of Yangzhong Town, Youxi County, Sanming City, Fujian Province, China. The village government is only 500m away from Beijing-Fuzhou expressway in Euclidean distance

(*Figure 1*). The weather is mainly rainy and humid, and the village is at a high altitude, this factor affects the moisture conditions of the area. There is a large presence of springs and streams with the mountains around the north, south and east creating a barrier to the wind. The enhancement of the area make this place unique, such as its history of the buildings, agricultural land resources, rice, tea, mining, industry and the beauty of the natural landscape of the mountains surrounding the village of Guifeng.

The village streets are pedestrian only and follow the trends of soil morphology intertwining and creating tunnels between the picturesque stone houses, earth and wood. The access to the village is a road under construction and currently in clay from which you reach the square/parking area, and the tea house of this study is located in the middle of the village, close to the main stream (*Figure 2*). This house has two access points, one on the north facade as the main entrance, and the other on the west side as a point of secondary and service access.
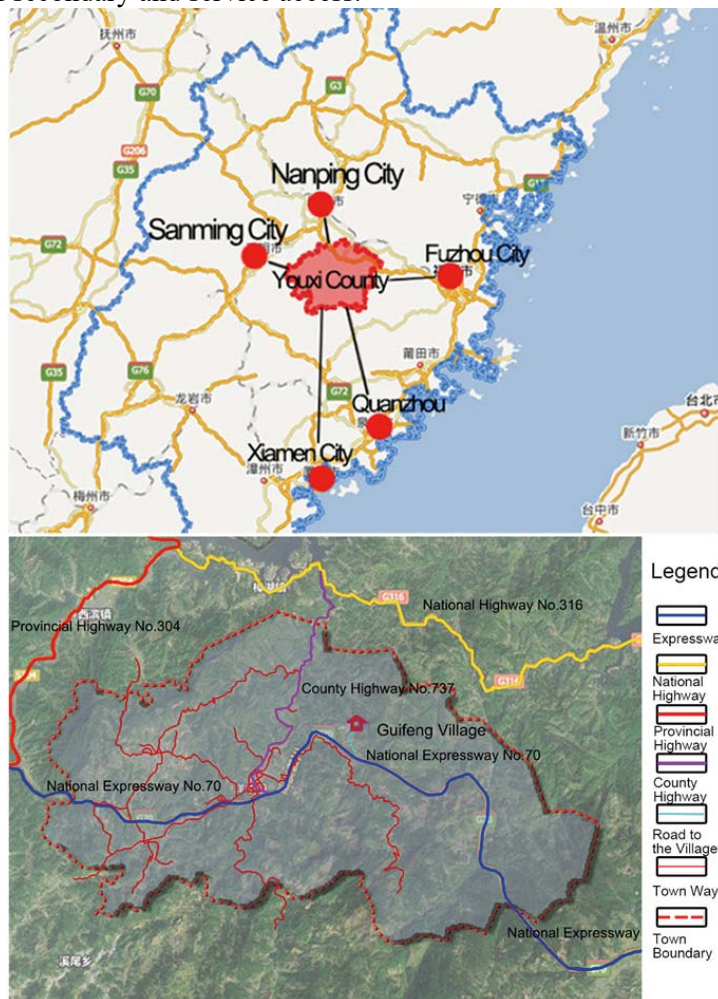
Figure 1. The position of Guifeng Village
Source: The protection planning design of Guifeng Village, 2014

Figure 2. The position of the tea house in Guifeng Village, drawn by the author

3.2   Historical evolution

Guifeng Village has a long history lasting more than 760 years. Because of the main surname Cai, Guifeng was once called "Cai Ling." Later, there was an official road from Youxi to Fuzhou through here, and it was the only transit station and accommodation for Youxi dignitaries, merchants and hawkers to and from Fuzhou. Then, Guifeng quickly flourished and became also known as "Little Fuzhou"(Jin, 2012).

The tea house of this project belonged to the Cai family, and there was a time in the Qing Dynasty when the front house was used as a teahouse mainly for people passing by. They would buy a cup of tea to drink, or mainly bring the homemade local tea back home. They were rich people when the house was built, but not so rich after the 1960s to nowadays. There used to be five families living there at most. This house has never collapsed or been burnt. It has been repaired twice, once was in the late Qing Dynasty and the other was in the 1970s or 1980s. After that, it began to be ruined. In 2000, the village government organized repairing this building for tourism, but it was interrupted because of lacking funds.

The tea house shows the features of buildings in the past. The shape of the roof, the position of the stairs, the structural composition and so on was due only to the ability of craftsmen and builders. It consisted of two rectangular buildings, which are not in the same horizontal position (*Figure 3*). The rooms beside the road were shops and rooms on the floor above were used for storage and service. The halls on two floors of the back house were for public use, and the shrine in the hall on the first floor was for worshiping ancestors, other rooms were bedrooms.

Figure 3. Photos of tea house

4.   APPLICATION OF BIM IN TRADITIONAL BUILDING INVESTIGATION OF PRESENT SITUATION

The approach of traditional buildings' protection should follow the principle "first rescue those important traditional buildings which have endangered structural and hidden safety trouble", then diagnose its structure and develop programs about restoration and renovation (Zhang, et al., 2008). The present situation investigation of traditional buildings is a very important part of the process and initial survey is often done to better understand the building.

4.1   Drawing the surveyed data of tea house

We generally choose a hand-held laser rangefinder for surveying or 3D laser scanner if the buildings are valuable heritage. Drawing the surveyed data of the tea house with CAD means drawing a projection of each side of the building. In this way, we first draw two-dimensional projections of each side of the tea house, then mark the measurement data on a draft. Since the recording of the data is intensive, different projections are generally drawn by different people, finally forming a set of drawings (*Figure 4*). Because different people process the surveying data in different ways, it is prone to problems such that different drawings' data cannot be connected. Elevation and profile contains a large number of components, such as brackets, pillars, beams and others, so it is very tedious and prone to error when drawing the elevation and profile.
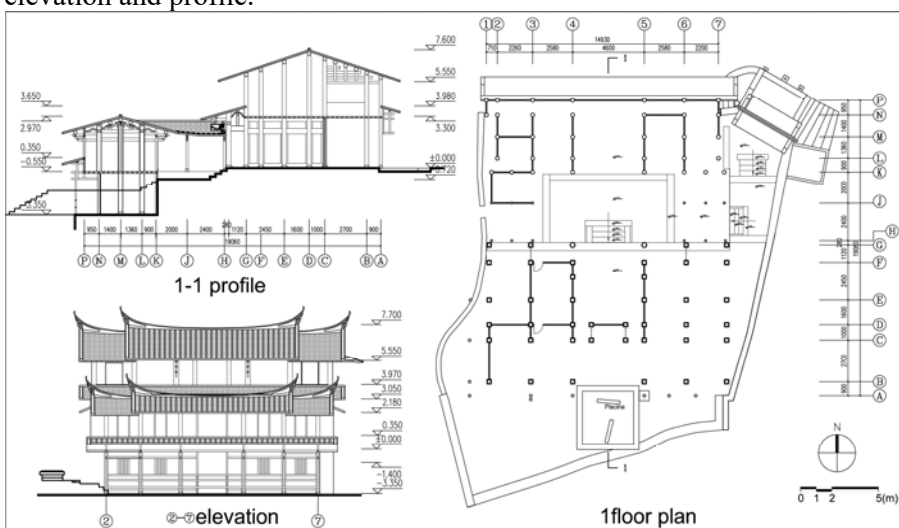
Figure 4. The CAD drawings of tea house

BIM is based on three-dimensional graphics, and it eliminates the process of drawing two-dimensional projections, avoiding the drawing of erroneous projections and bringing inconvenience for the paradigm shift of mapping personnel between two- and three-dimensions. It is not like CAD's division of labour in accordance with plane, elevation and profile, but according to the division of the building components. For example, when the beams and pillars structure of the tea house are drawn, first of all we draw a beam and a pillar, then we define each of the major data for the corresponding length, width and height attributes, finally, these data will appear in the list of family type. Other beams and pillars can directly be quoted from their respective component family in the repository, and record information by directly entering the property value. With some simple operations in the plane and elevation, BIM builds a 3D model directly from the data information (*Figure 5*). Because all of the projections are different ways to express the same information model, BIM does not show inconsistencies between plane and elevation, and modeling itself is equivalent to the data collation. If we want to receive a two-dimensional view, we only need a few simple operations such as marking elevation, sectioning and so on, then it will automatically generate the desired view (Sun, et al., 2014).
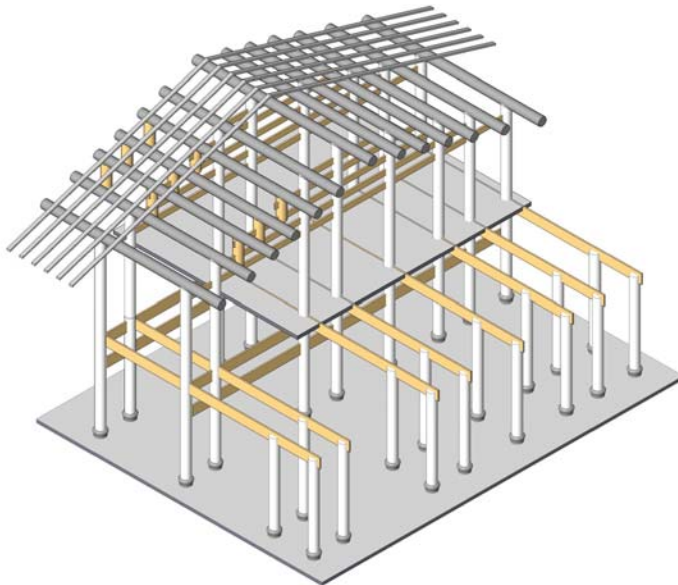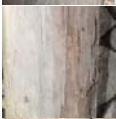
Figure 5. The 3D models of the tea house's beam and pillar structure

4.2   The visualization of information

For traditional buildings, they carry a lot of information. In addition to the size of the data, a great deal of non-data information is important, such as the background of the relevant building, damaged levels of components, and the cultural information of the building. Before building the model of the tea house, we can organise the current situation issues table of the tea house's pillars and beams through field research (*Table 1*). Through this table of photos and text, we can know the main damage of the tea house's structure. This qualitative data information reflects all the problems about the tea house in its experience of the changing times, which included both natural and man-made disasters.

Table 1. Current situation issues table of pillars and beams

Issues	Picture	Description
Shrinkage cracks in the wood		The shrinkage cracks cause structural problems naturally occurring in the wood when it is dehydrated after its implementation; the change in temperature as in this case may enhance this phenomenon.
Deep shrinkage cracks or breaks		In the case of continuous and rapid changes in temperature and/or when the column is subjected to excessive weight loads, deep fissures are created in the wood till the break of the carrier occurs. Rupture is a normal stress for an axial load.
Deformation in buckling		The deformation of the load-bearing column is due to natural factors; the wood presents axial deformations in Y-axis. Or is deformed due to the load. Other deformations and/or swelling can be caused by moisture.
Rattan laces		The connection with rattan is used to reinforce the pillar in the intersection with one or more beams. Most of these laces are destroyed by insects and they had no more function.
Shrinkage for beam insertion		Fractures and vertical slits are to be attributed to the adaptation of the wood for the insertion of the vertical element. With moisture, permanent load and other factors such as xylophagous insects, the problem can be accentuated requiring new supports within the column to support the beam.
Missing parts		The lack of parts or elements in the entire column can be attributed to two factors, anthropological, where parts have been removed to be replaced, or due to erosion by fungi and insects. In both cases, the replenishing of these elements should be implemented.
New wood/new addition		The replacement of whole carriers was accomplished without paying attention to the study of the existing case-pillar prospectus South Regarding the restoration of contact between column and base in the case of failures, the operation was carried out in an approximate way without solving the underlying problems.
Decay fungus white/brown		(Synonym: rot) Degraded wood caused by fungi that causes progressive loss of mass, mechanical strength, hardness and generally also variations in colour and appearance. These fungi can be active only if the wood has higher moisture of (18-20%). The type of decay is found by its white fibrous appearance and bleached wood and brown rot.
Holes, flicker of wood eating insect		Animal or vegetable organism that procures their nourishment from the wood. The holes created by these insects are particularly common and can give rise to structural problems and missing parts.
Gallery of insects on the surface		Gallery built by insects (usually by termites) with different material (dirt, excrement, etc.). Attached to the outside of the building to move from one area to another.
Mould		This term is used generically to indicate superficial mycelial growth of fungi, typically in environmental conditions of high humidity.
Moss		They occur when there is plenty of water and may become black when there is poor lighting, and otherwise turn green. They have behaviour similar to other plant species, as they procure physical degradation when the root system penetrates deep into the cracks and produces a chemical degradation by substances secreted from the roots.

Smoke and carbonization		The presence of smoke and carbonization is due to rituals that were using smoke for the ancestral hall, and is also found in areas used for food preparation. The phenomenon is manifested by the blackening of smoke particles. The focus of this was too close to the structures and has resulted in a superficial carbonization of wood.
Metal element		Presence of metal elements such as nails inconsistent and unnecessary from the structural point of view for the functional building. Their position is probably due to the necessity of hanging candle lamps or furniture.
Surface erosion		Disrupted surface due to removal of small fragments from the wood surface, by various factors, such as rubbing of solid bodies, or impact of particles carried by the wind or liquid streams. Sometimes it is differentiated between those areas of spring wood and late wood, according to their relative hardness.
Humidity		Amount of water contained in the wood, expressed as a percentage by mass dry weight of the wood itself. Being highly hygroscopic, the wood can exchange moisture with the surrounding air, and can also absorb water, which may be in contact.
Exposure to UV rays		Factor of degradation of the wood surface, which if exposed for long periods has surface discoloration (graying) and micro-cracks by ultraviolet radiation (through photo-oxidation processes and depolymerisation), and infrared radiation (by heating).
Efflorescence		Training superficial appearance of crystalline or powdery or stringy, usually whitish in colour.

BIM's system of information input is completely dependent on the model, and process modeling is the process of information input (Sun and Xu, 2012). When building the models of the tea house's beams and pillars, except for the data information, we input the above table about structural degradation, alteration and degradation of the material and so on at the same time. The family model comes with a system containing perfect parameter mechanisms for designers inputting, but the family model that we build ourselves can allow adding of the needed information to the properties dialog box of components. According to the classification of the current situation issues table, we input the specific attribute of each beam and pillar, and then the system will automatically generate the current situation attribute table of beams and pillars (*Figure 6*).
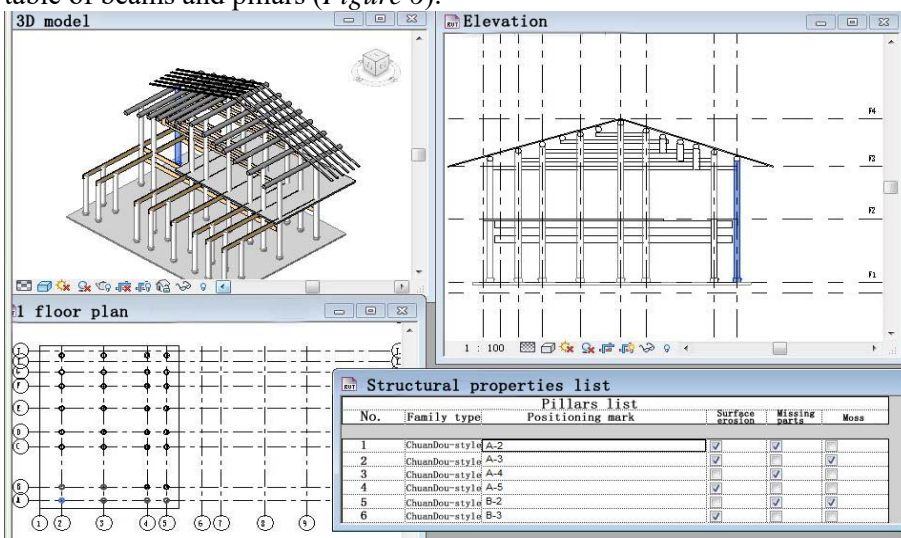
Figure 6. The interface of Revit model

After knowing the current situation attribute of every beam and pillar, we can get the appropriate disposal measures for the pillars on the first floor, such as cleaning and maintenance, partial substitution and reinforcement or entire substitution (*Figure 7*). Traditional architecture is made up of a large number of complex wood components mainly. In the building regeneration process, different treatment means treating different situations of members, and the problem most of the members faced are complex. Developing targeted measures needs scientific statistical analysis. For example after inputting information to each component according to the current situation issues table (*Table 1*), BIM can build up an information table to help find the key issues. Then we can summarize the corresponding proposals which are suitable for traditional buildings in the countryside (*Table 2*), and combine them with each component in the implementation process.
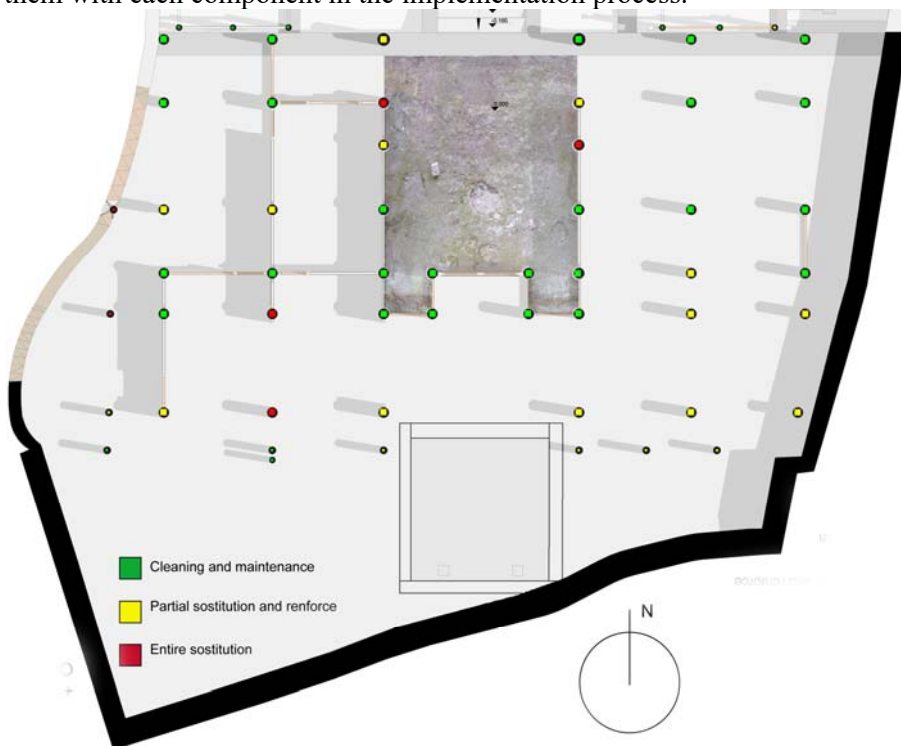
Figure 7. The appropriate disposal measures of the pillars on the tea house's first floor

Table 2. The intervention proposals

Metallic elements incoherent	Mechanical removal of the elements that are damaged by oxidation of the woody parts, using cleaning solvents with surfactants.
Solution for the glue on wooden elements	Removal with hot steam and scraping off the glue and paper with a plastic spatula, if necessary with sandpaper.
Removing paint from plaster and graffiti	Hydroxide sodium or hydroxide potassium. Pack with absorbing substances such as talcum powder.
Solution for black smoke on wood elements	Clean the stained surface with a cloth dampened with a mild solution of soapy water, rinse well with clean water and dry immediately passing the oil.
Moss	Remove with a rubber spatula and water, if it were not enough, use chemical biocides.
Intervention for white or brown fungus	Eliminate or reduce the problem of moisture through the drying or forced ventilation, remove the contaminated area and two coats of fungicide spray at a distance of at least two meters for destroying any spores in the air.
Intervention for xylophagous insects	Treatment micro-node, natural, is based on heating at 55°C of the entire trunk, allowing the killing by dehydration and hyperthermia of woodworms. The most severely damaged parts should be removed

	and replaced with wood previously treated against insect attack. Treatment with permethrin-based solvent. Preventive treatments will be carried out with boron salts.
Mould	Do not cause structural damage but create aesthetic problems, can be removed with simple cleaning bleach and water or any antiseptic treatment such as chlorine. For the most affected areas it is okay to use sanding or sandblasting.
Salinity and efflorescence	Ascent or descent by capillarity is formed by salts. Remove steam with muriatic acid distilled in water, 1:12. You can also use wraps with the solution to dissolve the salts, use packs of paper. Give hand protection with natural oils or acrylics. Done every two years, every four with natural acrylics.
Weathering and UV protection	Sandpaper and remove dust. Dealing previously with wood with a coat of water-repellent treatment to protect it better. Use of oils such as linseed oil or oils in the acrylic latex.

5.   APPLICATION OF 3D VIRTUAL MODEL IN TRADITIONAL BUILDINGS

5.1   The 3D design scheme

The purpose of the regeneration of the tea house is due to the importance and strategic location of this within the village for tourism purposes and the promotion of local products of the village. Being a predominantly agricultural village and having experienced first-hand the dishes of the place there is a good idea that the tea house should have the function of restaurant but most of all it should regain its original function as a tea house and a meeting place of passage.

The following is the design scheme. The second floor will function as the tea rooms with divisions intact. On the ground floor, the underside of the tea rooms will be used as exhibition space, the topics will vary from the history of Chinese tea to the beautiful landscape paintings of the historical personalities of the village; the space in front is clear of furniture and seating is provided to observe the village overlooking the Shen Gui creek. The floor below ground will be used as shops selling local crafts and tea (*Figure 8*). It is from this desire to want to reopen house shops to the public, a better location could not be found if not in direct contact with the road along the creek. So in a way it flows back to the original interior of the house with shops open and in addition it is necessary to remove the thin expansion of the existing port entrance and add a new port.

Conducting the protection and restoration of traditional buildings just by providing text descriptions will make the owner confused, and most of them do not want to protect the traditional buildings because they can't see what the traditional buildings will become in the future. Now, they can easily know the design ideas of the project by 3D virtual model, the partition function, the restoration of structure, the roof and so on (*Figure 8*). Except for the overall isometric drawings of the buildings, BIM also can provide any corner of the virtual reality scene of the traditional buildings (*Figure 9*). BIM can create an immersive visual, and it automatically generates an image from the height of human sight (*Figure 10*).
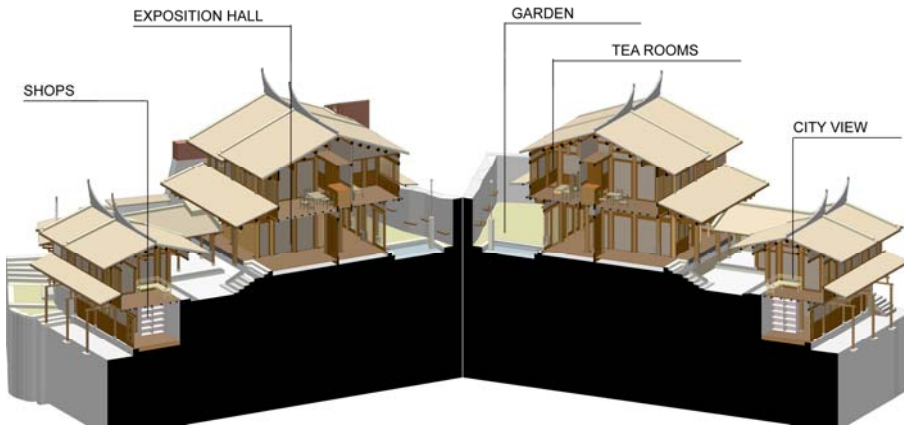
Figure 8. The 3D virtual model of tea house

Figure 9. The virtual scene of tearoom
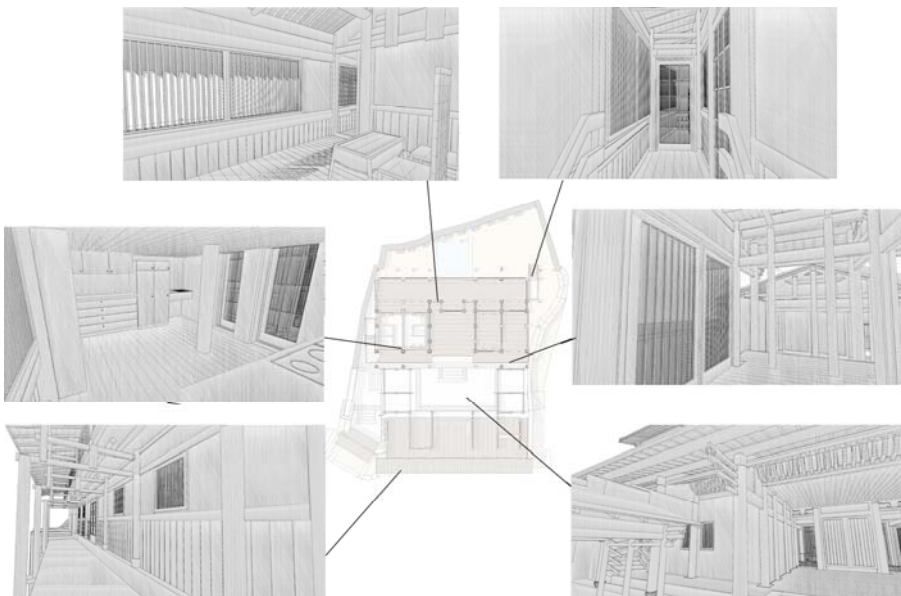
Figure 10. The interior scene model of tea house

5.2   The specific practices of components

We can understand the construction steps of traditional buildings from the station base to the roof, and it is easy to know the changes of the pillars and beams in the tea house with the information model. In this case, considering the integration of partial pillars, problems are more concentrated in the base of the pillar so proposed integration with removal of the damaged part, using a new steel structure is practical. Some cases of strong deformation and cracking will be eased with the creation of new unions and increasing the cohesion of the element itself, which can hoop with root or for more severe cases of carbon fibre. Second, we replace entire bearing elements. Due to the severe cracking they should be fully replaced, the replacement of the central elements is also required because there are no masonry unions preventing its removal. Finally, construct the new structure for beams. Some rooms on the second floor present fragile resistance, with the support of two new beams and pillars that depart from the floor below, we will be able to keep the beams excessively not consumed by degradation to lay new flooring (*Figure 11*).
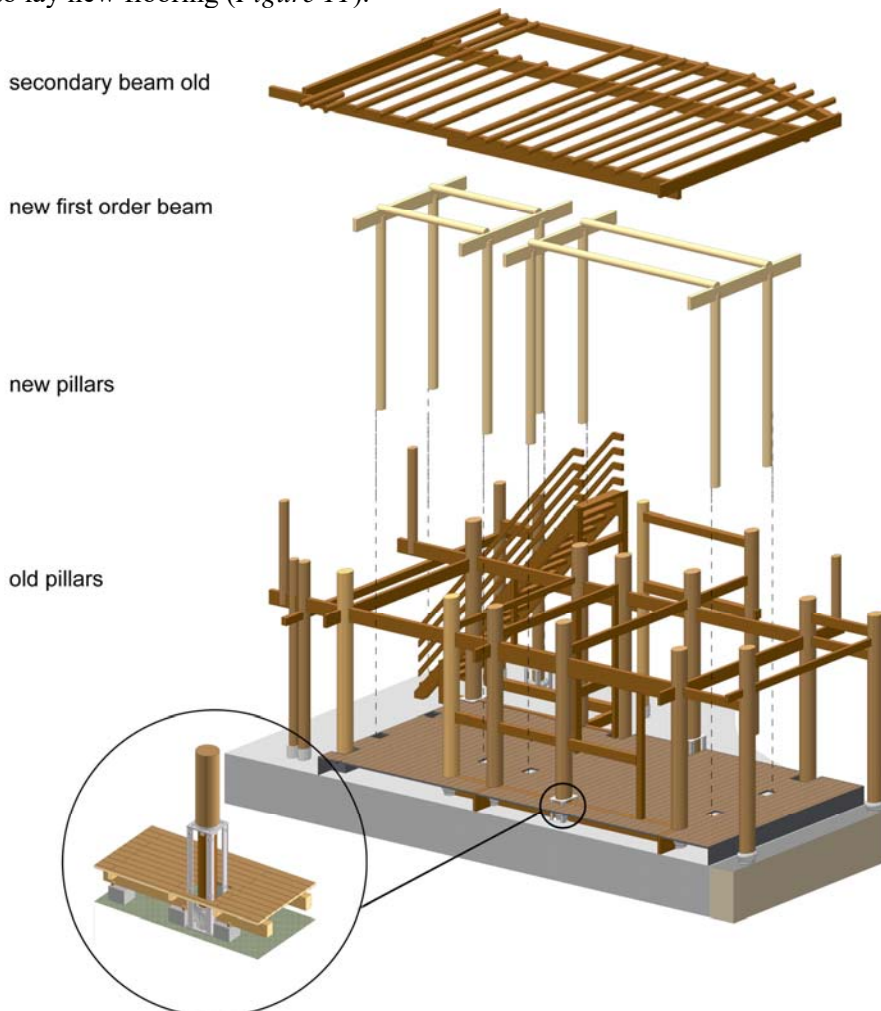
Figure 11. The specific practices of components in tea house

BIM makes the progress of drawing the plane, elevation and profile simple and visual. It expresses the approach of components more intuitively. For the new steel section of pillar for example, we cut the decaying wood of the pillar and temporarily hold it stable with media that anchor the pillar at the upper end below the slab inter-story, then we weld the base plate with the

L profiles, place it below the stone plinth, bolt the plate above the L profiles previously welded to the supports and spike the pillar's ancient elements arranged below the upper plate. At last we glue the supports for the glass to the L and the glass glue on supports. L-shaped elements and glass will be previously dimensioned to fit the corrupted part of the pillar (*Figure 12*).
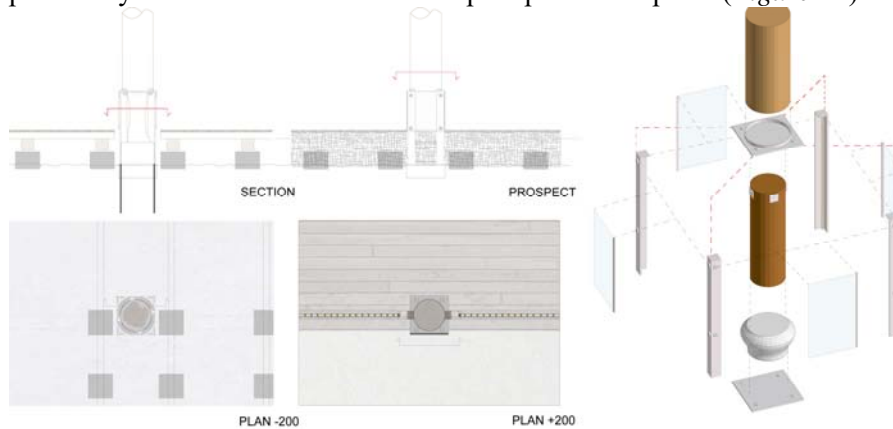
Figure 12. The new steel of pillar in tea house

5.3   Other applications of the information model in traditional buildings

There are other functions of information modeling in the current situation of traditional buildings, such as the economic evaluation of protection projects, information sharing of traditional buildings, data docking with the three-dimensional laser scanner and so on. In addition to enhancing the visualization of traditional buildings, there are some features very important for the protection of traditional buildings that can be demonstrated with the 3D model of BIM, such as the simulation of disaster response, virtual construction and docking with ecological software, et cetera (Zhao, et al., 2012).

6.   CONCLUSION

Traditional buildings often use comparatively low energy and durable materials, and traditional neighbourhoods are often characterized by density, short distances and mixed use, which make them a relatively efficient model of sustainable development. Therefore, the protection and regeneration of traditional buildings can play a pivotal role in the sustainable development of the city (Zhang, et al., 2015). Faced with a wide range of traditional buildings, we cannot always use the previous method of protection, so the introduction of BIM is very meaningful. It can completely replace the traditional survey drawings as design and construction data can be archived for inspection at the time of the traditional building's repair in the future. Relying on the recording of components' size and process data of traditional building information modeling, we can repair or replace the residual components. Based on the record of components' size and material data of the information model, we can also make the missing components based on the original.

In the practical application, BIM still has existing issues that need further exploration and solutions: First, its popularity is low, and most people cannot use Revit modeling. Second, the information model of BIM contains

a large amount of information, so different departments of the project need to cooperate with each other, which is a test for the project management.

In this paper, the applications of BIM in traditional buildings are explored, referring to the Qing Dynasty tea house in Guifeng Village. There are still many shortcomings in the building information modeling because of the time and technology limitations. Focusing on the application of BIM in traditional building surveys and 3D virtual modeling, there will be a more in-depth study following up.

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"Attending Nearby Schools" in Central Beijing: Influencing Factors and the Policy Distortion

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Abstract: Whether the principle of 'attending nearby schools' is an obligation or an option makes a big difference in promoting education equity. This paper explores how the setting up of a *de jure* catchment area together with other complex socio-economic factors in China's context distorted the initiative intention of 'attending nearby schools', via a case study of Xicheng District in central Beijing where quality public schools are concentrated and their catchment areas were accurately divided. With the unbalanced distribution of basic education resources formed by history, the remaining controversial *hukou* system, and the rapid urban and social transformations increasing parental choice, a contradiction exists within the Chinese public school enrolment system where the admission right is directly bound up with residential registration (*hukou*): an emphasis of equal access to basic education, but an opposite outcome. In order to reveal the causes and effects of the 'attending nearby schools' policy in practice, the paper illustrates the spatial pattern of *de jure* school catchment areas by GIS-based mapping, explores the relationship in demographics classified by *hukou* status between the schools and catchments and collected representative opinions among residents on the policy implementation through semi-structured in-depth interviews. By explaining the disparity between school composition and the residential pattern of typical catchments with the choice behaviours of non-native/native groups, the paper discusses the legitimacy underlying the current enrolment system and makes suggestions for future reform.

1. INTRODUCTION

The fundamental relationship between basic education and location lies in the fact that children usually attend schools near their homes (Ingram and Kenyon, 2014). Parents would prefer to send their children to nearby public schools if there is no other priority than distance, making it a natural right of them (Li, 2007). While considering the objective differences in school quality and the rising diverse parental choice (Tsang, 2001), the moving costs for either relocating or long-distance commuting occur inescapably if parents intend to get access to any 'best school' instead of the one near home, which is a tough situation for planning policies aimed at minimizing the travelling distance to school.

Reducing inequality in the distribution of quality education resources across regions and groups sounds a plan satisfying both the convenience of schooling nearby and the desire for high quality education. But it is not easy

to set the evaluation criteria during the process of reaching that ideal state in practical policy making. Although assuring equal access to basic education is hammered repeatedly as a general principle in public education systems of most countries, not all sides of the goal can be guaranteed simultaneously and there have been two distinct ways practiced and discussed in certain contexts.

One way is to assign pupils mandatorily in the form of school district or school attendance zones, under the legal privilege of 'attending nearby schools', which is adopted in the mainland of P. R. China (China) as a typical example (Li, 2007). In China, "attending nearby schools" solely accounts for the legitimacy of a school district system in the sense of education equity and thus becomes an obligation (Zhu, 2001). According to the *Law of Compulsory Education* enacted in 1986 and revised in 2006 in P. R. China, the governments at all levels should ensure the right of 'attending nearby schools' for national school-age children. However, with the current *hukou* system (the registered residence system) fixing public welfare with registered residence locations, such a term is said to be defective in that a child may have no access if he or she is not available for attending a public primary school near the registered home, as is seen in the cases of migrant children (Yang, 2006).The other way is to allow or support school choice in education policy which turns attending nearby schools into an option for parents, just partly considering the distance between school and home, as in the case of England and Wales (Hamnett and Butler, 2013). In other developed countries such as the US, despite having a typical structure of school districts, it is also experiencing an overall trend to develop diverse alternatives for school choice (Ingram and Kenyon, 2014). However, 'choice' is intricately bound up with resources in the form of financial, locational and cultural capital, which are unevenly distributed across the population (Reay, 2012). The main western countries have evidenced many practices undermining equity related to school choice such as 'choice by mortgage' (Taylor, 2007), 'white flight' or 'catchment evasion' (Noreisch, 2007), as well as the increasing distance to travel to school by individual motorized means (Easton and Ferrari, 2015).

The challenge of finding the appropriate balance of increasing equity and bolstering choice is always quite difficult for public sectors. In tackling this challenge, it does make a difference whether "attending nearby schools" is an obligation or an option in light of the inevitable parental choice. To contribute to the socio-spatial outcomes of the principle for international comparative studies, it is necessary to reflect on the foundation and operation of the school district system in China. Given the dilemma worldwide, we question its implications in the name of 'nearby enrolment', 'improving equality' or 'forbidding school choice', to see if it makes sense in achieving these ideals by implementing a mandatory policy. In addition, we also assume that similar problems could even be worsened by the uneven distribution of education resources and their institutional legacies in a transition period characterized by rapid urban development. The central metropolitan areas, such as Beijing, are typical cases. The situation there remains to excavate where the factors above combined with the strict catchment-area-based enrolment system bring socio-spatial inequalities in primary education. The system, in an opaque environment, may exactly lead to the failure of attending nearby schools, which can tell us that the factual access is not just homogeneous or equal across urban areas and social groups, whereas its role with the influencing factors behind distorting the principle deserves more concern.

Against a background of very little previous work on the socio-spatial presentation of the school district system in China, this paper seeks to address a number of important issues with specific quantitative and qualitative methods combined, via the case study of Xicheng District in Beijing, the national education highland. The principal questions to be examined are: the extent to which pupils attend schools came from outside their home catchment in the study area; the typical reasons for the preferences of groups with different *hukou* status; the systematic factors influencing the achievement of equal access to basic education and the consequent distortion of the school district system on attending nearby schools. The structure of this article is as follows: in Section 2 the relevant contexts on the challenges of basic education inequalities in Beijing are reviewed, in companion with empirical evidences. In Section 3 the research framework, the data and methods mapping *de jure* catchment areas of primary schools and that identifying and investigating problem spots in the case study area are presented. Section 4 gives the results, the inferences and the analytical reflections from interviewers. Section 5 discusses the influencing factors from three aspects and the policy distortion on attending nearby schools.

2.   RESEARCH BACKGROUND

2.1   The Beijing Context

2.1.1 Uneven distribution of education resources

Due to the huge influx of immigrants of marriageable age and the expected baby boom in recent years (BICP, 2011), Beijing is experiencing unprecedented challenges in providing sufficient and equal basic educational services. Despite that, there have been declines in the total number of compulsory schools, which manifest the scale effects in running schools (Zhang, 2011). On the other hand, just like the situation of most Chinese cities (Wu, 2013), quality public schools in Beijing are historically concentrated in central areas while residential sprawl continues. In central districts the density of primary schools was 2.4 per square kilometre and the proximity was 694 metres on average, while the figures for suburban districts were 0.33 per square kilometre and 1871 metres (Huang, 2006). More and more pupils attend the 'best' school, not their nearest school by means of moving costs such as spending on housing relocation or long-distance commuting. The competition for public school places of good quality thus keeps intensifying nowadays, particularly in central districts where the gross educational capacity was overburdened with a highest load rate reaching 133%, while the lowest load rate was only 74% for the districts mainly outputting pupils (BICP, 2011).

2.1.2 Evidences of inevitable parental choice

Following society's progress, Chinese parents tend to select schools with a fine reputation and high teaching quality (Tsang, 2001), whereas the distance between school and home and policy-related costs seem to be playing second fiddle. The local market for owner-occupied housing has a key role in indicating this. Variations in school quality are usually

capitalized into housing prices and parents use the housing market as a way of competing for school places (Cheshire and Sheppard, 2004). It is also true for Beijing. The housing price in the *de jure* catchment area of a key primary school in Beijing is notoriously sky-high. In 2011, the premium of a key primary school district room in the Beijing property market was about 8.1%, which reached the equilibrium level of chosen school fees on average (Zheng, et al., 2012).The other sign is the excess commuting to school which contributes to traffic congestion, environmental pollution and even potential problems for public health. Researchers recently found that the traffic congestion degree on school holidays was lower than that on school days by about 20% to 30% in Beijing (Zheng, et al., 2014). Beyond such evidences, social investigations directly show that parental choice is inevitable. According to the public opinion poll on urban-rural planning implementation in Beijing (2013), 37.4% of households said that they would rather take a long-distance trip to attend a high-quality school (BICP, 2013).

2.1.3 Enrolment policy of public primary schools

Under such circumstances, quality public primary schools in competitive districts have made it clear to give priorities to the students with a *hukou* and even a housing property in a designated catchment area, a so-called *school neighbourhood* (Lai, et al., 2009) or *de jure catchment area* which is distinguished from the *school district* as the specified lawful spatial range for enrolment, while *school district* is not directly involved in enrolment. The school catchment-school district system in China is a two-tier discourse when referring to the service area of public schools. Since primary public school enrolment is a sensitive issue, only the official enrolment guides of each primary school are available to the public and the format of text addresses on them indicating its *de jure* catchment area has not been processed in any type of open maps at the time of writing. It is a vague concept in terms of spatial cognition. In contrast, the spatial boundaries of school districts in this sense are transparent and commonly overlapped with that of sub-districts (*Jiedao*), given its positive role in policy promotion. The term of *school district* used in basic education planning or other macro policy documents refers to a management unit for organizing educational resources by Districts/Counties, or a cluster containing several schools with cooperative relationships (BMCE, 2014).

In official terms, a *de jure* catchment area of a single or joint compulsory school is subdivided by the Education Commissions of Districts or Counties on the basis of school size, local school-age population, surrounding traffic conditions and administrative requirements etc., in order to keep a local supply-demand balance in basic education (Xian, et al., 2014). However, considering the huge spatial inequality on the whole, such form that serves to allocate school places to a rigidly designated area has been caught in a policy dilemma for certain. Only a school-age child with a *hukou* located in one *de jure* catchment area has the admission right of the corresponding school (Zou, 2012).Then children with non-native *hukou* could be reasonably put on the back burner in local decision-making as a result. They enter a public primary school only by providing an actual proof of residence or parents' residence permit to prove the legitimacy of actual residence, which is a disguised alternative requiring housing purchase in the designated area (Hu, et al., 2014). We can therefore see that the socio-spatial structure especially classified by *hukou* status in schools and the corresponding catchments

reflects both the direct projection of admission right relations and the underlying inequality in basic educational service.

2.2   The Case Study Area

The research sets Xicheng District, the education highland and the old city in central Beijing, as a typical case to explain the mechanism in education resources allocation. Xicheng District spans 50.7square kilometres and has 1,240,000 inhabitants (2010 National Census) which is subdivided into 15 sub-districts and 255 communities. There were 72 public primary schools (81 sites in total including 9 sub-sites) with 53,000 pupils in 2011 (BICP, 2011). Most of the schools enjoy a time-honoured history and the formerly key primary schools occupied 28% of the total (BICP, 2011). The district takes a lead in basic education with abundant quality educational resources formed by history. In contrast to the decent capability of basic educational services, the aggregate amount of residential space was relatively short, since the catchments of primary schools were strictly specified all along and the second-hand housing market there with the selling point of 'school district room' was in great demand.

According to the information from the officials of the Xicheng Education Committee, the division of *de jure* catchment areas has not changed much since the 1980s, and the number of registered native residents in the old city has not changed much in recent years based on previous census data. In old cities with quality public schools, *de jure* catchment areas were often accurately divided and in some cases only several buildings of a community are marked off (Yang, 2013). There might be a potential implication of regulating educational demands by fixedly defining them due to the co-construction or partner connections left there which could bring extra student sources from outside the *de jure* catchment areas. Although large-scale relocation from the old city of Beijing during past years has caused massive actual separation of residents from household registration, the original connection between local public service and the indigenous is almost always maintained for stability, regardless of the actual distance. Meanwhile the education demands from outside the district as well as that from the new immigrants within the district were considerable. So the mismatch related to the school catchment system tends to be more typical in Xicheng than in other peripheral areas of Beijing.

3.   RESEARCH DESIGN

3.1   Research framework

It is assumed that the most important role of defining *de jure* catchment areas was to regulate basic education demand by enhancing the costs of school choice and excluding foreign populations under the specific context above, which distorted the initiative intention of attending nearby schools. To verify this basic role, the first step is to reveal the distribution of admission rights by mapping the boundary, layout and pattern of *de jure* catchment areas on a fine scale. The second step is to recognize outliers or problem spots by exploring the mismatch between school size (classified by *hukou* status: native and non-native) and the nominal enrolment size (registered native school-age population) as well as the non-native school-

age population in the *de jure* catchment areas respectively. Then the research will reflect the comprehensive factors influencing attending nearby schools through identifying the common reasons for non-native/native groups' choices. The policy distortions of the school district system on it will also be displayed by contrasting the outcomes with original principles.

The framework diagram (*Figure 1*) shows the process to conduct this research. On the basis of the brief introduction to the status quo and the enrolment policy above, primary schools catchment areas within Xicheng District are mapped, then the mismatch analysis between the actual school size and school-age population derived from national census data in each catchment area is presented. The next part is the in-depth interview of non-native/native groups with reflections from them and the authors in an attempt to discriminate the factors influencing 'attending nearby schools'.
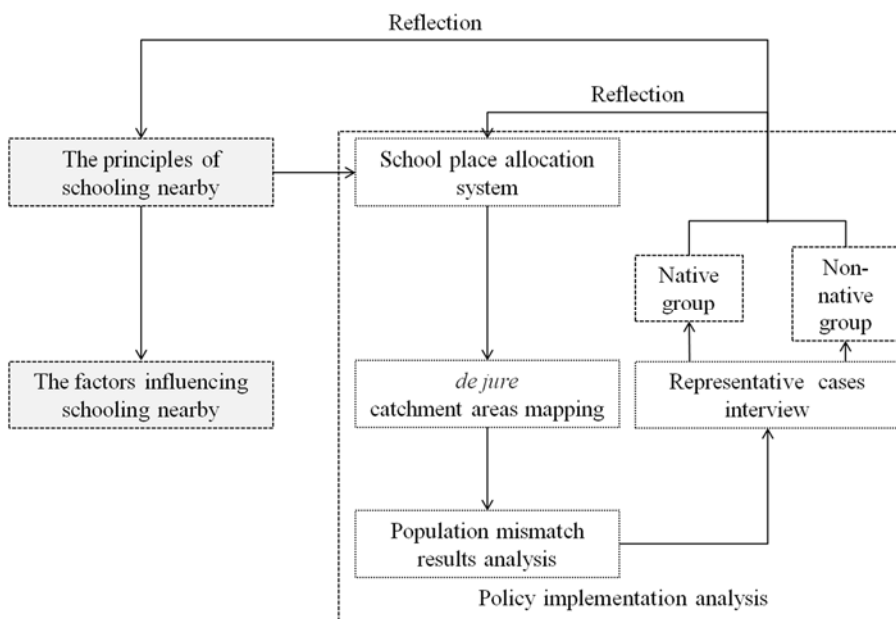
Figure 1. The framework to conduct the research on policy effects on 'schooling nearby'

3.2 Research methods

3.2.1 Measurement issues and data sources

The latest official enrolment guides indicating enrolment targets of 72 primary schools in Xicheng District in 2014 were gathered to draw the text addresses of residential buildings and compounds in each *de jure* catchment area. The raw data of *de jure* catchment areas in text format were matched with the aid of a fine-scale GIS database from a government source. The school size classified by *hukou* status of each primary school in Xicheng, as the indicator of service capability, comes from the Special Plan of Basic Educational Facilities in Beijing Municipality (2011).To reflect the detailed distribution of school-age (age 7-12) population and their *hukou* status as education demands, data from the 2010 National Census in Xicheng District on community-level accuracy were collected.

However, the raw data indicating the age property of population in each community had been synthesized into sub-district level, so there was a lack of accurate data of the school-age population at a community level. Due to the hypothesis that there was a similar age structure in one sub-district as in

its communities, the school-age populations were seen to be uniformly distributed in each community and each group (non-native/native) within one sub-district in this paper (*Table1*). The proportions were also adopted for the registered native population outside Xicheng as the floor levels counting the nominal enrolment size, since it is normatively estimated that school-age population (age 7-12) in the stage of basic education represents 3.6% of the total number of residents according to the Residential Public Service Facilities Planning and Design Standard of Beijing Municipality which is higher than all the proportions (*Table1*).The number of 'back schooling' natives thus would be underestimated but rectified in further analysis.

*Table 1.*Raw data indicating school age proportion and *hukou* status in 2010 Xicheng Census at sub-district level

sub-district	Resident population	Resident school-age population	School-age population proportion	Registered native population*	Non-native population**	Subordinate communities
Xichanganjie	51477	1508	2.93%	72874	19565	13
Xinjiekou	95497	2998	3.14%	103702	31085	21
Yuetan	116543	3685	3.16%	145094	29731	26
Zhanlanlu	130925	3577	2.73%	135954	40012	21
Desheng	116768	4104	3.51%	115259	28963	23
Jinrongjie	67888	2061	3.04%	109355	18085	19
Shichahai	95433	3039	3.18%	119437	32048	25
Dashilan	36997	940	2.54%	54873	13473	9
Tianqiao	46385	1201	2.59%	51799	13510	8
Chunshu	30547	812	2.66%	37047	8722	7
Taoranting	43455	1143	2.63%	54816	11238	8
Guanganmennei	73692	2043	2.77%	84808	17242	18
Niujie	51877	1202	2.32%	49405	12634	10
Baizhifang	95737	2463	2.57%	90277	22170	18
Guanganmenwai	179536	4384	2.44%	106666	58294	29
Total	1232757	35160	2.85%	1331366	356772	255

*It contains the numbers of both non-resident natives and resident natives which together will be compared to the amount of native pupils in primary schools as the nominal enrolment pool.
**It refers to the residents with *hukou* outside Xicheng but reside in Xicheng actually more than half a year and the number will be compared to the amount of non-native pupils in primary schools after the discount.

3.2.2 GIS-based mapping and mismatch analysis

Considering the situation of joint recruitment between several schools and branches, the catchment areas of such schools were consolidated and the total number of *de jure* catchment area was 65 as a result. 87.2% of the addresses in the official enrolment guides had their counterparts in the database through inquiry and the modification of non-standard addresses. Several special addresses were acquired through artificial interpretation. Areas of water, parks, business districts, protected cultural relics and sites that could not generate basic education demand were not delimited into them.

Each catchment area contained a certain number of school-age children (non-native/native) converted from the community-level census data. For the situation that the minimum population statistics unit, i.e., the community, was divided into different catchment areas, the number of population were assigned based on the area proportion of the delimited area to the whole of

the catchment area. The figures of the total school-age population and the constituent parts of non-native/native groups were matched with the corresponding parts in school size respectively (*Figure 2*). The mismatch termed here thus refers to the difference between the number of pupils attending a school and the number of school-aged residents in its catchment area. Each of them was classified according to their *hukou* status. The mismatch analyses were carried out not only to test their relationship but also to recognize overloaded schools and socio-polarized cases for interviews. Given the fact that not all native children actually lived within the catchment areas and not all non-native children actually enrolled in the corresponding school of the catchment areas they lived, the mismatch here calculated in quantity is an underestimation of the factual mismatching situation.
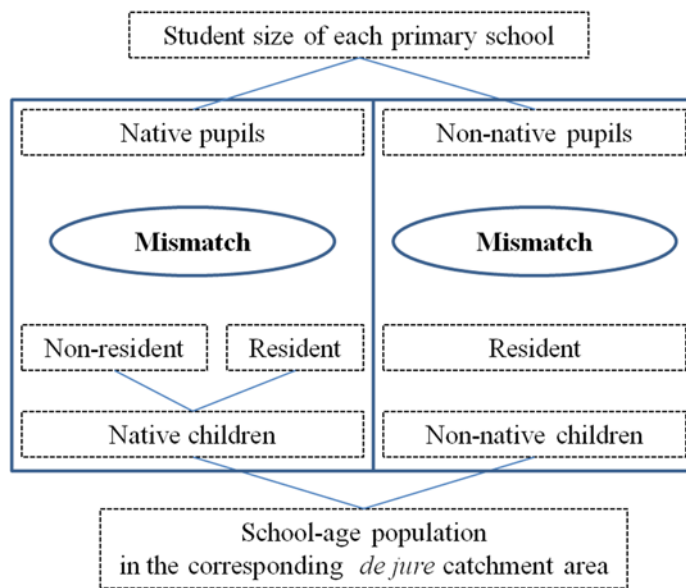
Figure 2. The objects of the mismatch analysis

3.2.3 Outlier recognition and in-depth interview

Bridging the gap between quantitative and qualitative research is necessary in order to understand the context within which the data have been collected and to understand the system that underpins the data (Gorard and Smith, 2004). The research drew on a variety of sources, including the records of 12 semi-structured interviews with parents from specified schools and from their catchment areas, as well as a number of interviews with other key bodies, including local politicians and school administrators. The interview samples were proportionally selected from the three most popular schools and the three most unpopular schools within their catchments in March 2015 (occasionally the most popular schools have the highest proportion of native pupils and the most unpopular schools have the relative highest proportion of non-native pupils). The main questions include 1) How far do you live from the school? ; 2) Does your child have a native *hukou*? ; 3) How did your child get admitted by the school? ; 4) What is your opinion on the current enrolment policy based on *de jure* catchment areas? Ultimately, even the most objective data will require the most subjective insight (Phillips and Plessis, 2003).The final results were balanced with the opinions from native and non-native parents as well as the present

representative ones to help explain the underlying reasons. Although the materials are only briefly analysed in this paper, they have been used to inform much of what is being said.

4.   RESULTS ANALYSIS

4.1   Inferences from mapping catchment areas

The map shows that the 65 *de jure* catchment areas in Xicheng District were subdivided mostly based on the boundaries of communities (*Figure 3*). The rigid shapes and sizes thus made the planning principle of service radius fail. The irregular form shave some features specifically verifying some problems in dividing *de jure* catchment areas as follows.

1) They were divided rigidly so that buildings within one block may be assigned to different catchment areas. In one case the boundary was even jagged regardless of the arterial road beyond (Sample 1 in *Figure 4*). They were divided not just for the convenience of daily commuting to schools.

2) A *de jure* catchment area may have a considerable part overlapped with another, which means that an address was the counterpart recruitment target for two schools (Sample 2 in *Figure 4*). That potentially caused a waste of resources due to the lack of coordination between schools.

3) The best school with the largest number of current students at school, together with its branches had a relatively minimum *de jure* catchment area (Sample 3 in *Figure 4*), which apparently had their nominal enrolment targets mismatched with the factual.

Figure 3. The subdivision of *de jure* catchment areas in Xicheng District

Further evidences also show that administrative factors prevailed in the division and complicated right relations could be identified.

1) A few primary schools had an independent part of their *de jure* catchment area spread in that of another school, i.e., an enclave (Sample 4 in *Figure 4*). It was an obvious spatial evidence for that it was the right relation, not the locational relation, connected the supply and demand sides.

2) There was also a situation that the addresses entitled with admission rights definitely pointed to the office buildings of a work unit, not just residential buildings. That means school places are specially assigned to the staff of the unit regardless of their actual residence.

3) It has been verified that some addresses in official enrolment guides did not refer to any places that still existed in reality. As a consequence of demolition in built-up areas and the renaming of some alleys, those addresses only represented the written household registration.

*Figure 4.*Special samples illustrating the rules of subdivision

4.2 Illustrating the mismatch results

From *Table 2*, the primary school size was overall close to the number of registered school-age residents (both native and non-native) within the whole District. 1/4 of the school capacity in Xicheng was shared by the non-native group and a small fraction of education demand of the native group had outflow, which may be caused by social transformation due to urban development. Meanwhile the total school-age population in each catchment area was approximately uncorrelated with the actual service capacity.

Moreover, the distribution of the school-age population across catchment areas was very uneven accompanied with an even larger variation in the school size. There was a potential polarized trend between schools as their intakes differentiated. In general, 41 schools could not meet the demand in its catchment area while the matching ratios of the six most overloaded schools being more than 100% (from 160.4% to 1164.5%). Even within Xicheng District which enjoyed an overall fine reputation of quality basic education service, the education inequality between schools was evident. Such overload rates were alarming indeed which means that only a small fraction of its students came from the surrounding areas with legitimate admission identity. These competitive schools had to satisfy the extra demand of school choice and the area around them may suffer from the problems of high housing prices and traffic congestion caused by drop-off and pickup during peak hours of school commuting.

*Table 2.*Matching results of primary school size and registered school-age population by *de jure* catchment areas

	Sum	Extremum	Mean	Median	StdDev
School Size	50140	3592 161	771	565	614
School-age Population*	49378	1894 187	760	670	398
Difference**	762	**3308** **-1176**	**12**	**-137**	**650**
Mismatching Ratio***	1.5%	1164.5% -79.2%	24.3%	-23.7%	164.8%
Difference of the Native	-2499	**3279** **-1192**	**-38**	**-163**	**639**
Mismatching Ratio of	-6.6%	1531.5%	13.1%	-39.5%	212.7%

the Native		-92.6%			
Difference of the Non-native	3261	437 -207	50	38	115
Mismatching Ratio of the Non-native	28.2%	535.2% -69.9%	67.2%	24.7%	124.4%

= registered native population (resident plus non-resident) and non-native population in each catchment area the specified proportion of school-age population in corresponding sub-district.

**= primary school size – registered school-age population.

***= (primary school size – registered school-age population) / registered school-age population.

We can also see that the standard deviation of difference in the native group was larger than the non-native group and the difference of the native group had more potential to explain the total mismatch result. The result of a crude correlation analysis demonstrated the disorder of enrolment at that time. There was a moderate positive correlation (R=0.8164, P<0.001) between the actual school size and the nominal enrolment size in *de jure* catchment areas (*Figure5*). The difference in the native group was increasing with the school popularity represented by school size while the difference in the non-native group had hardly a relation with school popularity. It can be inferred that the native group had a stronger capability to compete for popular school places than the non-native group and there was a sign that more non-native pupils were concentrated in less popular schools than native pupils. This finding supports the evidence of parental choice from the side. There definitely were informal admission channels beyond the regular admission process and it was very clear that primary schools with better attractions have retained more places for native pupils out of the *de jure* catchment area to choose.
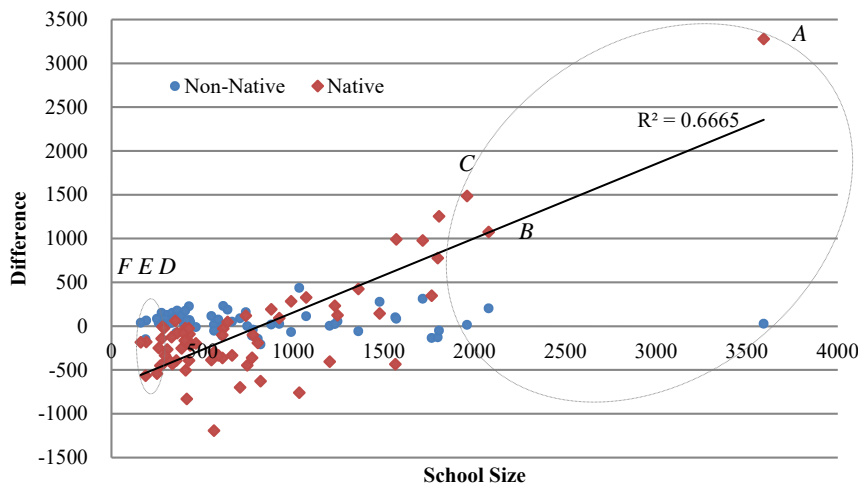
*Figure 5.*The variation of the difference of (non-)native pupils along with school size in *de jure* catchment areas and the representative cases specified for interview

The catchment area with the most popular primary school (School A) that is considered the outlier had an extremely high positive mismatch ratio in the native group. The other two representative cases (School B and C) followed and all the three most popular schools attracted a considerable amount of pupils, especially native pupils from the outside. There are potentially two kinds of circumstances. 1) There were many 'native' pupils outside the District whose parents worked for the units with a co-construction

relationship with a particular school while the *de jure* catchment area of those most popular schools were subdivided into too small units to regulate local resident demands. 2) Given that non-Xicheng but Beijing pupils were few in the native group and the situation where registered and actual residences were separated due to redevelopment projects in the past, the extra part could also be from those underestimated non-resident natives (see the measurement issues in 3.2.1) who had moved out of Xicheng but retained native *hukou*, or could have been caused by native pupils flowing across catchments within the District (the latter probability was small if catchments were accurately defined and well executed, or at least such a phenomenon was just isolated).

The bottom three unpopular schools (Schools D, E and F) in the graph were selected to be the other three typical cases that all had a high proportion of non-native pupils. The catchment area of School E was overlapped with key renovation areas in the old city and had experienced a massive outflow of local residents. Considering passive population decentralization, aging factors, quality reduction or other factors, there could be few natives coming back for schooling and such a school tended to be occupied by non-native pupils. Drastic redevelopment also brought similar situations to the other two catchment areas and there were few residential functions remaining in the current surroundings. The declining competitiveness of schools thus could be attributed to these negative exterior impacts besides the unknown interior ones.

4.3   Reflections on policy implementation

As in the case study of Xicheng District, there was a common consensus on that only a small fraction of pupils attending schools actually lived in corresponding catchment areas with legitimate identities, which was deemed as 'attending nearby schools'. Most pupils did not attend schools within home catchments according to a local administer. But the precise enrolment paths for different groups were very different. For the most 'powerful' natives and even a minority of non-natives in the interview, they actively choose the most attractive school and not necessarily lived in its catchment area.

More than 80% of the school intakes come from co-construction units of central and municipal level and are not regulated by regular admission process that is open to the public. Some of them may just have their hukou located in the catchment, but definitely most do not actually live there. The size of the de jure catchment area is too small and we all know the reason. The non-native pupils attending this school also have their connections. (An anonymous administrator in School A)

In the native group with advantaged conditions, the separation of residents from household registration also caused the capitalization of public welfare and potentially massive cross-district commuting.

Most old Xicheng residents relocated during the past years prefer to have their offspring return to the quality schools here. But I heard that it has become more difficult to retain Xicheng hukou for households moving out now if the housing unit is demolished. The best option for native relocatees is to keep your housing and rent out to immigrants but keep the hukou of that address for your children. But people coming to buy second-hand housing here are mostly for the sake of hukou. (A native parent in School B)

For native residents lacking the capability, locational bonus or opportunity to move out or choose a new location, some were facing the unpleasant invasion of non-native pupils and doubted the rationality of the school catchment system.

I'm not very satisfied with the division of school catchments and I don't know who has operated it. Even my residence is closer to a better school than the current counterpart but I have no right to choose it. The school now in my home catchment has gradually been occupied by migrant children. Several neighbours of mine are considering selling their houses because of this. I don't know if it is worthy, but not badly my child will graduate from it this year. (A native parent in School D)

Non-native parents, if qualified, would be satisfied by the availability of a school place regardless of the impacts of commuting distance or school segregation. They picked up the rest of the resources left by those natives during the integrated transformation.

We were fortunate to have been assigned to this time-honoured primary school as non-native families and most children here were like us. Although it is a little far from home, but we could accept any decisions of assignment then as long as a place was guaranteed. I guess there are hardly any pupils coming from the surrounding area since all these buildings have been renovated into offices and shops. (A non-native parent in School E)

But the ration scope for non-native groups was the whole District and the qualification was hard to attain. Apparently, most of them were out of the consideration of 'attending nearby schools'. Thus it could be argued that the inequality in access to schools was a result of unfair artificial treatment.

Hukou is a big problem. Although I have lived here for a long time, it seems that the catchments of primary schools have nothing to do with me. Even though I have passed and have the qualification to have my child rationed by the Education Committee, I know that the final admission will come from just a few schools fixed for us. (A non-native parent living in School C's de jure catchment area)

5.   DISCUSSION

5.1   Influencing factors on equal access

'Powerful' natives, 'back schooling' natives and the non-natives who were not strictly regulated by the catchment system constitute the main groups not 'attending nearby schools' in terms of the policy definition. Some reasons why this happened are evident based on the contextual information and analysis results above. There are three dimensions of causative factors summarized as follows (*Figure 6*): 1) the uneven distribution of quality basic education resources on the whole;2) active or passive parental choice due to urban and social transformation and 3) the institutional inertia resulting in an unequal enrolment system which differentiated social groups by *hukou* status and various informal connections (*guanxi*). Some other institutional, social and cultural factors are also listed beside the dimensions. Although the enrolment system targeted at 'attending nearby schools' increases the costs for parental choice, it is insufficient to curb such behaviours, and cannot be a determinant for achieving a local supply-demand balance in basic education.

On the contrary, it plays a crucial role forming unequal access to basic education under the synergistic effect of the three influencing factors.
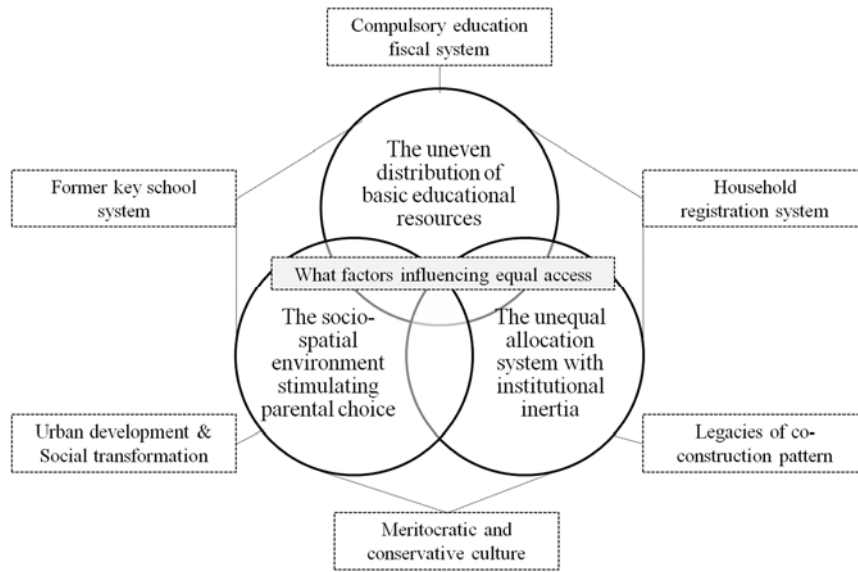
*Figure 6.*The three dimensions of factors influencing 'attending nearby schools'

5.2 The policy distortion on schooling nearby

'Attending nearby schools' is a sound principle of policy-making in school enrolment to connect residences with placement rights for both ethical connotations and legal privilege. But the greatest distortion of it in practice is that the compliance with the principle is executively judged by not an actual residence but a residence register or proof. Due to the local educational fiscal system that only serves the native registered population, it has been clearly stated in the law that the local governments shall ensure school-age children to enrol in the school nearest the places where their residence (*hukou*) is registered (but is not always consistent with their actual residence (Wu, 2013). A household registration system is the key in connecting property rights with admission qualifications that contributes to the practices of 'choice by mortgage' and 'relocate without transferring *hukou*' in central Beijing and it is definitely not suitable for the fact of increasing urban mobility. The disintegration of the work-unit system and housing commercialization all throw down the gauntlet to this traditional system of urban management. Indigenous people tend to stay in the old welfare system no matter where they move while new comers are facing high thresholds to get access to local public services. So not surprisingly, the conflict largely exists between the school district system aimed at suppressing parental choice, and the reality that the uneven distribution of quality educational resources, together with rapid urban expansion, has spontaneously increased the need for families to relocate or travel.

6. CONCLUDING REMARKS

The form of *de jure* school catchment areas in China which serves to allocate school places to a rigidly designated residential area mandatorily is insufficient to achieve "attending nearby schools" in basic education for

many reasons, but may give rise to the discrimination of different social groups. By a typical case study of Xicheng District, Beijing, this paper explores the implication of *de jure* catchment areas which directly represents the target area that public school places are allocated to by education sectors. The policy implication of attending nearby schools is quite different from that in terms of spatial proximity and the subdivision is doomed to be controversial particularly in competitive areas.

Mostly it can be seen as a 'top-bottom' administrative system focusing on allocating resources to designated targets, rather than the local structure, to organize the provision of basic education service and manage their daily operation. In the name of attending nearby schools/nearby enrolment, such a space-related admission policy adds the access to education service to different areas directly, which makes the planning principle of schooling nearby only in the sense of proximity fail. Given the education inequalities formed by history in China, this means that different inhabitants registered from different areas enjoy different admission rights only on account of locational bonus or administrative directives without participating in any management or undertaking any responsibilities, which worsens the unequal access to education in many ways. It is has little relation with the authentic meaning of 'nearby', neither to the standards of liveability nor to public opinions. Also, it is not difficult to understand why the visualized information of the *de jure* catchment area was not transparent to the public in competitive areas, since the justification in subdivision did not stand up to public scrutiny. Also the country lacks any incentive to increase schooling options such as public-private schools or special inter-district schooling plans for parents outside the sole school district system. Such situation is very distinct from that in western countries.

The influencing factors such as the unbalanced education supply, the increasing parental choice and the *hukou* system etc. are drawn to be underlying causes and there is definitely a complex situation in competing for public resources during rapid urban and social transformation. Since then the mismatch between school composition and the counterpart population have been considerable. Various responses to policies based on *hukou* status, social capital and locational advantage helped to describe the flaws of the system. In contemplating the framework of influencing factors, the role of planning and management sectors in rectifying the distortions of the enrolment system is highly anticipated in addition to the exterior efforts on equalizing educational resources. It remains a daunting task to overcome the institutional legacies that resulted in social inequalities and to innovate the mechanism of basic education provision. As can be seen from the subdivision of *de jure* catchment areas, only administrative factors dominate in dividing designated areas for enrolment and there lacks a clear acknowledged definition of 'nearby'. Such policies are directly related to public welfare and the operation should be modified in a process involving public feedback. After all, by tracing the roots of the problems, the achievement of attending nearby schools while assuring equal access is a systematic social project calling for progressive reforms in the whole system.

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Empirical Analysis of the Digital Divide from the Perspective of Internet Usage Patterns: A Case Study of Nanjing

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Abstract: There is a well-known ''digital divide'' in the tendency to connect to the Internet, but whether there is similar differentiation among Internet usage is still worthy of further exploration. Studies on the geography of the digital divide are more concentrated on the national and regional scale, with a lack of research on the micro-scale. This paper builds up an index system, uses the factors, clustering and regression to analyse the Internet usage level on spatial distribution and attributes characteristic influence factors, based on 2012 survey questionnaires about personal information usage. The result shows that there is a weak distinction in comprehensive Internet usage among Internet users from different social-economic groups, but differences in online activities are relatively significant and individual social-economic attributes and properties of location and housing of residents have a significant impact of different usage patterns.

1.   INTRODUCTION

Numerous studies on sustainability have shown that the essence of sustainable urban development is the coordination of different dimensions and sustainable development is a multidimensional process that integrates environmental, social and economic aspects (Tiyao SUI-QUI and Hong LENG (2015)). With the improving of urbanization and economic development, China is experiencing increasing disparities in wealth and other aspects. Urban researchers are more focused on the social aspects of sustainable development such as residential segregation and social differentiation (Zhigang Li, Fulong Wu (2008)). In the background of the information society, focusing on the aspect of the impact of information and communication technology (ICT), the digital divide is proposed as a sub-area of social inequality. As an important issue in the field of ICT and its social impact studies, the digital divide has received much academic attention ever since the information revolution. In the second half of the 1990s, attention on the subject of unequal access to and use of the new media started to focus on the concept of the so-called digital divide (Van Dijk (2006)). The main research of scholars focuses on how differentiated levels of the digital divide may contribute to social inequality. Castells (2001) argues that "in a society where most things that matter are dependent

on Internet based networks, to be switched off is to be sentenced to marginality". Graham (2002) and Crang and Crosbie et al. (2006) noted that the digital reflects the socio-spatial stratification phenomenon to some degree. Fong (2001) and his colleagues pointed that the digital divide reflects the huge differences in the level of information among different social groups. Traditional research by scholars always measures the digital divide via access to the Internet or indicators of the quality and quantity of digital resources (see Bessey (2003), Chang, Bakken, et al. (2004), De Haan (2004), Ortiz (2008), President (2005), Robinson, Dimaggio, et al. (2003), O'Hara K., Stevens (2006), Salinas (2008), Smoot (2007), Warschauer (2003)). Mack (2001) defined the digital divide as the ability to pay for or have access to computer software, hardware and information channels of new information media. O'Hara and other researchers noted that the digital divide is segmentation between information rich groups and information deficient groups, which is an either-or concept (O'Hara K., Stevens (2006)). Mingfeng Wang (2005) defined the digital divide as the differences between the Internet users and non-Internet users. But the differences represented by the "divide" are not just caused by the uneven level of Internet access from devices, but it is caused by the inequality of a series of information, knowledge and services that comes with Internet access. This implied "value divide" of the Internet is derived from the diversity of Internet usage patterns and cannot be easily bridged through equalizing Internet access. Internet technology access only is not sufficient to prove the productive use of the Internet. In contrast, the Internet usage of different users can be used as a research object. Therefore, at the second level, research on the digital divide also went deep into the differences in the use of the Internet, as well as differences in terms of information and knowledge. Van Dijk (2003) and other researchers noted that the digital divide is a very complex phenomenon because of the existence of information inequality as an intermediary in the communication process in the use of digital technology or computers, including the ICT usage skills and usage patterns. Cooper and Weaver (2003) expanded the connotation of the digital divide from the access to technology to the use of technology skills and training. Attewell (2001) considered that the digital divide has transcended the first-generation stage to the social differences of computer usage among different households and schools. Lai (2000) pointed out that the digital divide is not only the gap between development and application of information technology, but it is the gap between information and knowledge acquisition and utilization capacity.

Between different individuals there exist differences between user skills and experience of the Internet. As the Internet permeates daily life, Internet usage differences and its social impact will become more apparent. On the basis of an online activity survey data, starting from two perspectives, we measure comprehensive internet usage levels, and compare specific online activity patterns of different individuals who already have internet access and usage conditions, then we explore its influencing factors combined with social and spatial properties of individuals, to empirically research on the digital divide from the perspective of diverse Internet using patterns. This empirical study in Nanjing may also add to the literature on the social implications of the Internet, which has been largely developed from studies in the western context.

2.   DATA AND METHOD

2.1   Data

The data for this study come from a detailed survey of a 2012 Nanjing residents' behaviour questionnaire in the information age. As a deputy central city of China's Yangtze River Delta economic zone, Nanjing occupies the front rank among the nation's level of economic development, as well as an advanced information level. Therefore, Nanjing was chosen as a study region. The survey is carried out to focus on daily behaviour of urban residents in the information age, including Internet adoption details, Internet usage of e-office, e-entertainment, e-shopping and e-travelling areas, and a number of demographic variables. Samples were distributed in 11 administrative districts in Nanjing and we conducted household surveys in a number of communities with different characteristics within each area. 1038 copies of questionnaires were distributed, 980 valid questionnaires were recovered. Excluding some samples which did not have network access conditions and those with more than half missing values, a total of 885 samples are used for the following analysis.

2.2   Evaluation Index System

Currently, the majority research related to the "Internet usage" tends to focus on the general description of differences in the intensity of use. To measure the Internet usage level, in this paper, we build an evaluation index system starting from two aspects of intensity and diversity to objectively measure the comprehensive level of internet usage. We generalize five principal types of online activities and then select 13 secondary indicators, considering the intensity and diversity of Internet usage. Using a factor analysis method, we aim to obtain an objective and comprehensive evaluation of the Internet usage level.

Table 1. Internet usage level evaluation index system

Type of Internet Usage	Secondary indicators	Description
E-office	X1: Online office frequency	0,1-2,3-5,6-10,11-20,21-50, more than 50 (times per week)
	X2: Home office network frequency	0,1-2,3-5,6-10,11-20,21-50, more than 50 (times per week)
	X3: Email using frequency	Frequently, occasionally, never
	X4: Diversity of e-business	See note 1
E-shopping	X5: E-shopping frequency	0,1-2,3-5,6-10,11-20,21-50, more than 50 (times per week)
	X6: Diversity of E-shopping	See note 2
	X7: Group buying frequency	Frequently, occasionally, never
E-entertainment	X8: E- entertainment frequency	weekly frequency
	X9: Diversity of E-entertainment	See note 3
E-travelling	X10: Using the Internet to query travel route	Yes/No
	X11: Diversity of E-travelling	See note 4
E-social networking	X12: Using hours of social network	Less than 0.5, 0.5-1, 1-3, 3-6, more than 6 (hours per day)

	X13:	Diversity	of	E-social	See note 5
		networking			

Note 1: Diversity index of e-business=$\sum X_{4i}$, i=1,2,...5, includes online office, contacting and communicating with customers, browsing news, searching destination information, checking traffic information and purchasing tickets.

Note 2: Diversity of E-shopping =$\sum X_{6i}$, i=1,2,...10, includes virtual goods, clothing shoes, bags, digital products, home appliances, beauty and hair care, baby products, home building materials, food specialty, merchandise, books.

Note 3: Diversity of E-entertainment =$\sum X_{9i}$, i=1,2,...4, includes online music, online games, online literature, online movies.

Note 4: Diversity of E-travelling =$\sum X_{11i}$, i=1,2,...5, includes transport routes, traffic conditions, weather conditions, destination information, transportation.

Note 5: Diversity of E-social networking =$\sum X_{13i}$, includes QQ (or MSN), Weibo, Feixin, Baidu BBS, Tianya BBS, Renren, Kaixin, Douban, Dazhongdianping and other social networking sites.

2.3   Research Method

This study is composed of two main parts. In the first part, to analyse the usage patterns and distinction of Nanjing residents, we evaluate the comprehensive Internet usage level on the basis of the index system using a factor analysis method and then observe the general Internet usage patterns among different groups. After using an orthogonal rotation method of principal component analysis for 13 indicators, screening out two main factors, we adopt a KMO (Kaiser-Meyer-Olkin) and Bartlett test. The KMO value is 0.714, which suggests that the original variables are suitable for factor analysis and total variance explained reaches 59.23%. Then we analyse their social and spatial distribution of different social groups according to the Internet usage level.

To analyse the usage patterns of different social groups, we divide residents into different social class groups. After selecting some of the residents' socio-economic indicators and calculating the final level score by equally weighting and summing together, we divide individuals into three clusters of high, medium and low level according to the final level score. Combined with comprehensive Internet usage level and five sub-index score statistics of the residents, we analyse the usage pattern and distinction among different social groups.

In the second part, we explore factors that may be related to the difference of Internet usage by using a multiple regression model, combined with the socio-economic characteristics of the residents of the properties. We create dummy variables for whether people engage in certain activities on the web and use these as the outcome measures.

3.   ANALYSIS OF INTERNET USAGE DISTINCTION

3.1   Comprehensive evaluation of the Internet usage

In this study we use a factor analysis method to evaluate the comprehensive Internet usage level of Nanjing residents based on the principal component composite scores calculated. As the final score has both a positive and negative value, we normalize the evaluation index values in order to facilitate subsequent statistical analysis, then we compare and analyze the Internet usage patterns based on the individual attributes of age, education level, housing type and residential location.

From the evaluation results (see *Table 2*), we find that there are significant differences in comprehensive level of Internet usage among different age groups and people of different educational levels. With the increase of age and the decrease of educational level, Internet usage levels are significantly decreasing, residents from the age group younger than 34 are at the highest level of Internet usage, followed by residents of 35-54 age group, residents older than 55 are at the lowest Internet usage level. From the aspect of education level, residents from Masters or above education level are at the highest level of Internet usage, followed by residents from bachelor education level, and residents from junior high school and below, high school, secondary and tertiary college are at the lowest level. As for residential location, Internet usage levels are gradually decreasing from the inner city to the outskirts. Internet usage level of the inner city residents is significantly higher than those from suburbs and the outskirts. It is evident that the widespread use of the Internet has not compensated for the lack of spatial accessibility, in contrast, Internet usage reduces as the accessibility weakens. In addition, there are slight differences among residents from different housing types. Residents from rental housing groups are at the highest level of Internet usage, we believe the reason is that residents living in rental houses are mostly young white-collars who have just graduated from college. In both the work requirements and the acceptance and use of new technology, they are much higher than other groups, and thus occupy a higher level of the Internet usage.

Table 2. Mean value of Internet usage

Age	Mean	Education	Mean
<23	0.6301	Junior high school and below	0.5299
24-34	0.6280	High school, Secondary and tertiary college	0.5596
35-44	0.4957	Bachelor	0.6254
45-54	0.4798	Master or above	0.6715
>55	0.2685	-	-
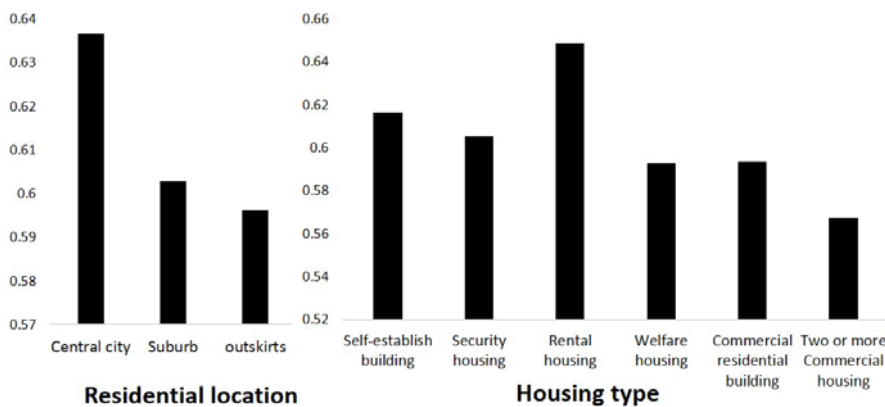
Figure 1. Mean value of Internet usage in different residential locations and housing types

3.2 Analysis of the usage of the Internet among different social classes

To further explore the distinctions in Internet usage among different social classes, we select residents' social and economic attributes including

education level, income and housing type, and calculate the final level score by equally weighting and summing together. According to the final score, we divide the samples into three categories: cluster 1, cluster 2 and cluster 3, respectively representing high, medium and low social class.

Firstly, according to the Internet usage level score of the three clusters separately, as shown in the second column of *Table 3*, it is evident that there was no significant difference in residents' comprehensive internet usage among the three clusters (standard deviation is 0.0432), and compared to the lower and the higher class level clusters, the middle class residents show a certain degree of superiority among the three groups.

Table 3. Mean value and standard deviation in different online activities of three social class groups

Social class	Internet usage level	E-shopping	E-entertainment	E-social networking	E-office	E-travelling
Cluster 1	0.59	0.56	0.64	0.41	0.53	0.38
Cluster 2	0.61	0.57	0.62	0.36	0.63	0.43
Cluster 3	0.58	0.42	0.61	0.23	0.52	0.46
Means	0.59	0.51	0.62	0.33	0.56	0.42
STDEV	0.0162	0.0839	0.0153	0.0929	0.0608	0.0404
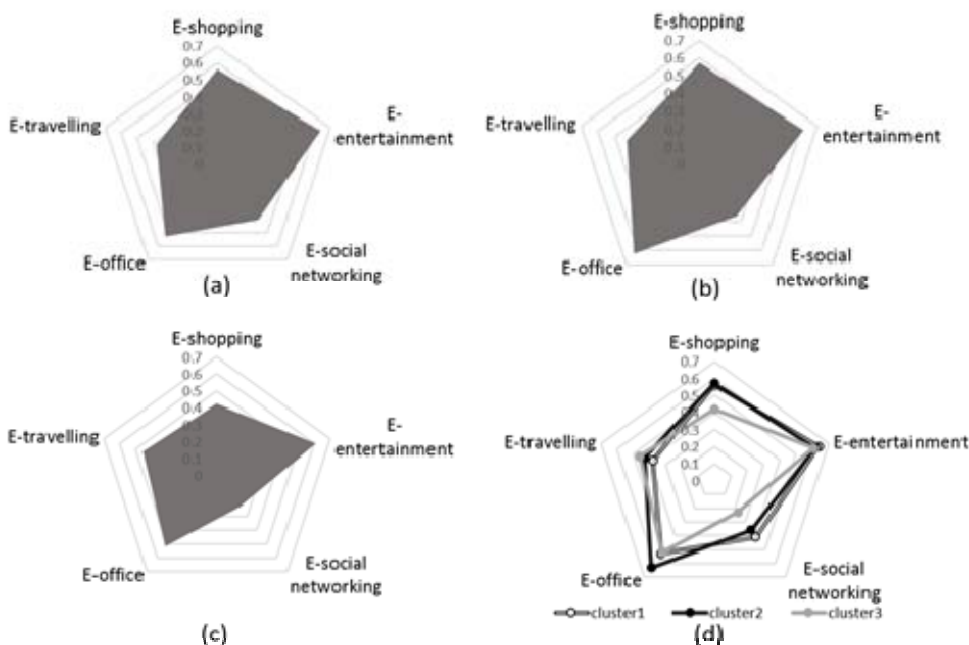
Figure 2. Internet usage patterns of three social class clusters: (a) cluster 1; (b) cluster 2; (c) cluster 3. (d) Three clusters' overlaid

Secondly, we further explore the distribution of the different patterns of the residents' online activities. Through the statistical descriptions and analyses of five categories of online activities of different social class groups, we find that although there is no significant difference in the Internet usage level among the three clusters, there is still differentiation in the choice of online activities among them to some degree (see Figure 2).

Overall, the online activities' distribution patterns of the different social class clusters approximately converge. In all three classes, the total mean values of the E-entertainment are the highest, followed by E-office and E-shopping, the E-social networking and E-travelling are the lowest. The

distribution indicates that compared to travel behaviour and social networking, the Internet plays a more important role in entertainment, office and shopping aspects in people's daily life among the three social class clusters.

Then, through the comparison of different distribution patterns of online activities among different social class clusters, we can see that in the E-entertainment area, the differences of Internet usage levels among the three social class clusters are the smallest (the standard deviation is 0.0153), followed by the E-office and E-travelling area (the standard deviations are 0.0404 and 0.0608, respectively). Relevant research indicates that socioeconomic status makes a significant difference on peoples' travel behaviours (Xihe Jiao, Ying Jin et al. (2015)). Through our study, there are also some class-reliance phenomena in the E-travelling behaviour. E-travelling level rises with the increasing of class status, which corresponds with their travel ability. Moreover, middle class groups are the highest in E-office value, which indicates that middle class groups have the highest information level in the business and office area. In addition, there is a relatively significant difference in areas of online shopping and social networking level among the residents of the three social classes (the standard deviations are 0.0839 and 0.0929, respectively). In the E-shopping and E-social networking areas, higher social class groups are significantly lower than those from lower class groups, which indicates that among all the online activities, E-shopping and E-social networking are more attractive to lower social class groups. Thus, from the distribution of online activities, we can conclude that in the virtual Internet world, there is also some "stratification" phenomena. Residents from different socio-economic backgrounds are at some degree differentiated in online activities. Higher social class groups' online activities focus on capital-enhancing activities, which verify the existence of a "second gap" in the ICT divide.

Possible reasons are due to the higher levels of education and income, higher access opportunity to diverse information technology equipment, as well as more advantages in learning and mastering new technologies; middle social class residents' Internet usage levels are higher than that of lower classes. While, although the higher social class residents are higher at the education level and income level than middle class groups, due to differences in the amount of leisure time, differences in the opportunity cost of leisure time and differences in the utility of online activities, which together determine the choice of Internet usage, they tend to choose higher beneficial online activities and capital enhancing activities. We conclude the following inference, unlike Internet access and equipment, the threshold for the use of Internet is relatively low and there is no significant difference among different social class. Even without the trendy, high-end Internet equipment, residents of lower classes can also carry out various and plentiful online activities, fully enjoying the convenience of the Internet.

4.   INFLUENCING FACTORS OF INTERNET USAGE

4.1   Model and Variables

On the basis of the survey data, after the evaluation of the Internet usage level of Nanjing residents, we explore and analyse the influencing factors of residents' Internet usage level from the aspects of individual social-economic attributes, housing types and residential location using a multiple regression model (for detailed samples see *Table 4*). The models are as follows:

ln (comprehensive level of Internet usage) = f (gender, age, education level, income, housing type, residential location and other social-economic attributes)

(1) In our study, we pay more attention to residents' social and spatial factors on the influence of the Internet usage level, so the model introduces various socio-economic factors and location factors. Taking the residents' occupation and income into account may be quite relevant, we only introduce an income variable into the model, without a consideration of the impact of the occupation factor.

(2) As for the housing type aspect, we select six variables including self-established building, security housing, rental housing, welfare housing, commercial residential building, two or more commercial housing, meanwhile the self-built house is set to be the reference group. Considering the current situation of urban development in China, combined with detailed analysis of the samples, we find that most self-built houses are located in the suburban fringe residential districts such as Jiangning, Pukou, Liuhe and outskirts residential fringe districts such as Yuhuatai, Jianye District. To some degree, the self-built housing samples can reflect characteristics of residents' surrounding urban building environment, accessibility and situation of living and service facilities.

(3) The above analysis results show that there is a certain degree of spatial differentiation in the comprehensive level of the residents' Internet usage, so we choose the residential location in the location variables to examine the factors that influence the level of the residents' Internet usage. Residential locations include central city, suburb and outskirts, altogether to analyse the relationship between the Internet usage and location factors.

Table 4. Statistical description of the samples and variables in the regression model

Variable	Quantity	Percentage%	Variable	Quantity	Percentage%
Gender			2000-3000	176	19.9
Male	441	49.8	3000-5000	295	33.3
Female	444	50.2	5000-8000	121	13.7
Age			≥8000	66	7.5
<23	243	27.5	**Housing type**		
24-34	508	57.4	self-established building	22	2.5
35-44	103	11.6	security housing	42	4.7
45-54	23	2.6	rental housing	200	22.6
>55	8	0.9	welfare housing	110	12.4
Education level			commercial residential	475	53.7

			building, two or more commercial housing	36	4.0
Junior high school and below	26	2.9			
High school, Secondary and tertiary college	301	34.0	**Residential location**		
Bachelor	433	48.9	Central city	256	28.9
Master or above	125	14.1	Suburb	344	38.9
Monthly income			Outskirts	275	31.1
Less than 2000 yuan	227	25.6			

4.2 Results

After selecting the influencing factors affecting the dependent variables, we construct models for the Internet usage level and Internet office, Internet entertainment, Internet social networking level of Nanjing residents - three main focus indicators, and then conduct a multiple regression analysis using SPSS Statistics 19.0, the results are shown in *Table 5*.

(1) Social and economic attributes of individual residents have a significant influence on the level of Internet usage. Overall, the variable of the age level has the most significant impacts on the individual Internet usage, concretely embodying the maximum absolute value of the regression coefficient of the Internet usage, Internet entertainment and Internet social network models. In each model, the level of Internet usage in all fields demonstrates a significant decline with the increasing of age, which indicates that young people below 34 are the most active users of the Internet, and groups who were born in the 1980s and 1990s always have an advantage in terms of accepting and mastering new things. The variable followed is the education level. In the Internet business model, the variable of the education type has the most significant influence. In all four models, the usage of Internet shows a significant increase with education's increase. In contrast, the impact of gender factors is much smaller, apart from the Internet office model. Gender factor plays an important role in the E-office area. The level of online office of the male group is significantly higher than for females (regression coefficient is 0.933). In other areas, gender difference in Internet usage is not significant. As for income levels, comparing the monthly income of less than 2,000 yuan group residents, residents' Internet usage level and online office level showed a rising trend with the increase of the overall level of income. In the Internet e-entertainment area, residents from the 2000-3000 yuan group are at the highest influencing level, indicating that low-income residents spent more time in the online entertainment activities.

(2) Different types of housing have a significant impact on online entertainment activities of the residents, compared with the Self-established building housing type residents, security housing, rental housing, welfare housing, commercial residential building, two or more commercial housing factors all showed a significant but weak negative correlation, indicating that

compared to the central city residents, whose surrounding is an urban building environment, where the accessibility and situation of living and service facilities are more complete, online entertainment activities of urban fringe residents whose surrounding circumstances and facilities are poor, occupy an important proportion of all online activities. In the field of Internet usage and online social networking, different housing types for Internet usage does not significantly affect the extent of usage and has a weak impact on it. But the comparison with the regression coefficients shows that as the housing level upgrades, there is a negative trend and a positive middle correlation which shows as an inverted "U" shaped trend. Combined with the presence of China's housing market, housing types have a close relationship with the residents' social status, which confirms the above inference. To a certain extent, Internet usage level differs little between different classes; middle class usage levels are slightly higher than lower and higher classes.

(3) The Internet usage of residents from different residential locations is different. There is a decreasing tendency in the comprehensive level of Internet usage from the inner city to the outskirts. Compared to residents in the suburban areas of the city, residents from central city areas show a more significant positive correlation with the level of Internet usage (the regression coefficient is 0.202), while suburban residents' level of Internet usage shows an insignificant and weak negative correlation. As for the influence of online office, the central city residents were also significantly higher in number than that of the outsider city resident users. In the field of online entertainment, there is a significant but weak negative correlation between the suburbia residents and outskirt residents, which is not in contradiction with the residents of housing types regression results. Because of the rough geographical division, the results could only reflect the rough trend, it tends to conceal more specific factors such as the individual surrounding urban environment, accessibility and the surrounding facilities and so on. In the area of social networking, compared to residents in suburban areas of the city, the central city residents present a significant positive correlation, and the suburban residents showed a significant negative correlation, indicating that the influence of social networking on the outskirt residents is weaker than on inner city residents.

Table 5. Regression result of determinants of Internet usage level

Variables	Internet usage level		online office	
	B	t.	B	t
(Constant)	-0.357**	-1.868	4.006***	0.004
Social and economic attributes				
Gender (set female as a reference)				
Male	0.054	0.997	0.933***	2.365
Age (set younger than 24 as a reference)				
24-34	-0.153**	-2.123	-0.049	-0.092
35-44	-0.689***	-6.895	-2.831***	-3.876
45-54	-0.890***	-4.614	-3.048**	-2.161
>55	-1.541***	-5.879	-6.133***	-3.200

Variables	Online entertainment		Online social network	
	B	t	B	t
Education level (set Junior high school and below as a reference)				
High school, Secondary and tertiary college	0.298**	1.848	4.420***	3.754
Bachelor	0.487***	3.029	6.052***	5.147
Master or above	0.650***	3.776	6.825***	5.419
Monthly income (set Less than 2000 yuan as a reference)				
2000-3000	0.122*	1.450	1.671***	2.712
3000-5000	0.179***	2.224	2.317***	3.934
5000-8000	0.015	0.157	2.311***	3.199
>8000	0.263**	2.196	4.785***	5.458
Housing type (set Self-Established building as a reference)				
Security housing	-0.094	-0.763	0.845	0.935
Rental housing	0.017	0.154	1.145	1.386
Welfare housing	0.053	0.370	1.077	1.030
Commercial residential building	-0.043	-0.389	1.367*	1.695
Two or more commercial residential building	-0.082	-0.523	1.212	1.060
Residential location (set suburb as a reference)				
Central city	0.202***	3.399	1.188***	2.730
Outskirt	-0.001	-0.019	0.280	0.552
R^2	0.205		0.211	
Adjustment R^2	0.181		0.188	
Sig.	0.000		0.000	
(Constant)	0.632***	13.965	14.171***	10.716
Social and economic attributes				
Gender (set female as a reference)				
Male	0.007	0.564	-0.020	-0.054
Age(set younger than 24 as a reference)				
24-34	-0.044***	-2.579	-1.144***	-2.290
35-44	-0.141***	-5.854	-5.077***	-7.354
45-54	-0.154***	-2.879	-5.960***	-4.471
>55	-0.261***	-3.008	-9.378***	-5.177

Education level(set Junior high school and below as a reference)				
High school, Secondary and tertiary college	0.083**	2.213	1.351	1.214
Bachelor	0.113***	3.051	2.431**	2.187
Master or above	0.125***	3.172	4.032***	3.386
Monthly income(set Less than 2000 yuan as a reference)				
2000-3000	0.038**	1.906	0.391	0.672
3000-5000	0.027*	1.415	0.332	0.596
5000-8000	-0.015	-0.632	-0.773	-1.133
>8000	0.001	0.048	0.649	0.783
Housing type(set Self-establish building as a reference)				
security housing	-0.077***	-2.525	-0.494	-0.578
rental housing	-0.065***	-2.336	-0.843	-1.080
welfare housing	-0.073**	-2.064	0.369	0.373
commercial residential building	-0.066***	-2.423	-0.911	-1.195
Two or more commercial residential building	-0.041	-1.057	-1.633*	-1.510
Residential location(set suburb as a reference)				
Central city	0.009	0.603	0.642*	1.561
Outskirt	-0.041***	-2.487	-0.939**	-1.959
R^2		0.147		0.190
Adjustment R^2		0.118		0.166
Sig.		0.000		0.000

Note: 1. Dependent variables: the level of Internet use level, Internet office level, Internet entertainment level, Internet social networking level; 2. *** corresponds to a significance level of 0.01, ** corresponds to a significant level of 0.05, *corresponds to a significant level of 0.1.

5.   DISCUSSION AND CONCLUSION

Based on 2012 Nanjing online activity survey data, in this paper we give an Internet usage evaluation by building an evaluation index system using factor analysis, and compare and analyse different online activity patterns and distribution patterns of different individuals who already have Internet access and usage conditions, then we explore its influencing factors combined with social and spatial properties of individuals. We conclude that:

(1) The comprehensive level of Internet usage among the different social classes did not present a significant "divide" and there is an overall

distribution trend that the middle class is slightly higher than that of lower and higher class groups. The distribution indicates that diverse Internet applications and services have penetrated into the daily life of the residents; meanwhile the middle class residents have the highest ability in the use of ICT. There's a slight difference between Internet users from different residential locations and different housing types, indicating that the level of physical location and facilities and service status also affect residents' online activities to some degree. (2) Types of online activities have a certain degree of difference among people from different socio-economic backgrounds. Residents of higher levels tend to choose capital-enhancing and utility efficient online activities, while lower-middle class people tend to take options toward more recreational and social networking online activities, which determine some "stratification" phenomenon in Internet usage. (3) Among all factors, age and education level have the most significant impact on residents' comprehensive level of Internet usage, youth groups and the highly educated population have the highest level of Internet usage. Moreover, the main factors that impact different types of online activities may vary, in addition to two major factors of age and education level, other variables such as gender, income and residential location are also important factors influencing the office network. Male, high-income groups and inner city residents have a high online office level. Entertainment usage is significantly affected by housing type, more marginalized housing type groups choose more online entertainment activities.

Users' social and economic attributes have a significant impact on the type of Internet usage and online activities, the differences in distribution suggest that online activities of users from a higher socio-economic status are just an extension of offline activities. While, for users from lower socio-economic backgrounds, online activities and offline activities are complementary to some degree. But similarly, the type and effectiveness of online activities and offline activities are closely associated with their socio-economic background.

In the field of research on the digital divide, there is not much controversy in the existence and specific meaning of the first level of the access divide, but the presence and meaning of a second or even the third gap is still worthy of further exploration. Generally, the individual personal usage of the Internet is based on the needs of real life, as purely internal activities. There are many uncertain factors that lead to the difficulty of measuring and analyses. On the basis of analysis and demonstration of this study, we contend that this deeper level of digital divide can be understood from two perspectives. The first perspective is the comprehensive level of Internet usage. Overall, from the view of intensity and diversity of the level of Internet usage in daily life, the slight difference among users from different social and economic background suggests that there is not a significant divide in the digital usage. Residents from every social status could fully enjoy the convenience and service brought by the Internet. The other perspective is the beneficial utility of concrete online activities. Internet usage demands are different among Internet users from different socio-economic backgrounds, so the specific network activities they choose are diverse. This "stratification" phenomenon of the online activities leads to different levels of efficiency in the use of the Internet, resulting in a certain social impact. We cannot simplify this complicated level of the digital divide problem for any one aspect, but divide into two objective views. With the decreasing of the differences in Internet devices and online technical ability among different social class groups, there are still differences of this

persistent and insurmountable divide in the use of the Internet. On one hand there is a weak class differentiation, on the other hand it is fixing the class stratification.

In this study, there are the following deficiencies: because of the insufficient sample sizes, with most samples being from the middle-aged groups and people living in the main city, part of the data accuracy and regression significance is not high. Following studies should focus on the theory and methods of sociology, informatics and other related subjects on the basis of making up for these deficiencies. In addition, research should pay attention to the analysis of mechanisms and their deeper impacts besides just the identification of phenomenon.

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Study of Performance Assessment for Urban Renewal Project in Taipei City

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Abstract: When the city develops to a certain extent, the city will have some problem of aging. In order to solve this problem, the governments carry out "urban renewal" policies to cope with it. Urban renewal makes the urban land to reuse with the urban planning, the urban function to recovery, the life to improve, and to raise the public Interest. The Taiwan Government has published the "Urban Renewal Act" and "Bulk Reward for Urban Renewal" since 1998 to promote the urban renewal policies and civil participation. Taipei, though, is the earliest and the most experienced city in Taiwan which has already conducted 221 urban renewal projects so far, neither the projects themselves can present the specific interests created nor the government can assess the effectiveness of them. In recent years, a Data Envelopment Analysis (DEA) method is widely used in various fields. Because the process of urban renewal involves a variety of input and output factors, the relationship between them can be regarded as a major project for performance assessment. This study, therefore, categorizes the urban renewal projects in Taipei City as a decision making unit. The influential factors were further determined and divided into environmental, economic and social dimensions. Following this, the DEA method was used to evaluate the efficiency of urban renewal projects. Finally the outcomes of evaluation can be used as an approach for government and developers to propose an efficient urban renewal project.

1.   INTRODUCTION

After rapid development from the 1970s, urban areas in Taiwan are gradually faced with traffic congestion, deficiency in public facilities, deteriorating environmental quality, and slum buildings. Under these urban decay phenomena, urban renewal is regarded as an effective strategy to resolve urban aging and achieves the objectives of economic, environmental and social dimension for the city. The Taiwan Government has encouraged civil participation in urban renewal through measures such as "Urban Renewal Act" and "Bulk Reward for Urban Renewal" since 1998, which attempts to deliver urban renewal policies that meet the public demand. Moreover, the Government also intended to attract funds, human resource and executive power of the private-sector, which further accelerates the urban renewal process, and thereby to improve urban aging and enhance urban functions effectively.

Whitford and Ennos et al. (Whitford and Ennos et al. 2001) and Kao and Huang et al. (Kao and Huang et al. 2003) suggested that in response to the

environmental impacts from social-economic growth, the process of urban development must reduce environmental damage and excessive use of resources, thereby improving urban development efficiency. According to the Urban Renewal Portal for Construction and Planning Agency, Ministry of the Interior, the statistic data show that there are 221 urban renewal projects approved in Taipei City as of February 2014. Taipei is the area that owns the most experiences of urban renewal in Taiwan. Nonetheless, the aforementioned approved urban renewal projects do not specifically present the effectiveness that the projects intend to achieve. In addition, the investment funds, endeavouring of bulk rewards for urban renewal and the degree of economic, social and environmental improvements also lack objective evaluation methods. Consequently, both the developers and the government fail to effectively control whether or not the renewal projects chosen result in effective resource use and meet the expected objectives of urban renewal.

To incorporate the effectiveness of urban renewal into the project, Friedly (Friedly,1969) proposed that the performance of urban renewal can be evaluated through establishing urban renewal indicators and be estimated based on a cost-benefit analysis. Hence, this study attempts to analyse the actual effect of urban renewal projects in Taipei based on data envelopment analysis and discusses whether the input resources are utilized effectively with respect to the economic, environmental and social dimensions. The study expects to assess the input and output efficiency under the limited urban renewal resources. The result can further be regarded as a reference for choosing further urban renewal projects and adjustment on urban renewal policies.

1.1   Urban Renewal

1.1.1   Context of Urban Renewal

The change of environmental quality in neighbourhoods will inevitably draw value changes of neighbourhood properties (Schall,1971). The purpose of urban renewal aims to improve the urban environment, which consequently affects the environmental quality outside of the renewal area. Urban renewal can eliminate inferior quality of buildings and transform negative externality into positive ones which further increases the property value. The Taipei City Government started to promote urban renewal in the promulgation of "Taipei City Urban Renewal Implementation" in 1983. However, not until the approval and implementation of the "Urban Renewal Act" in 1998 did the public sectors and private sectors engage in a series of activities. The public sectors emphasize how to make urban land more developed through land use planning. On the contrary, the private-sector focuses on the profit of the real estate market (Lan and Lai et al., 2008). Hence, urban renewal is an investing behaviour for the private sectors, which involves real estate market fluctuation, cost fluctuation, renewal schedule, revenue generation and other risks. The government is required to provide incentives such as bulk rewards and subsidies in order to promote urban renewal through the power of private sectors. After 2000, measures of the bulk reward and availability of preferential funds were incorporated into the urban renewal policies which aim to encourage the private sectors investing in urban renewal while the government serves as a coordinator and supervisor. Namely, the private sectors invest in and bear the cost while the

public sectors give bulk reward to urban renewal projects through the review mechanism.

1.1.2   Benefits of Urban Renewal

As provided in Article I of the Urban Renewal Act, the purpose of urban renewal is to promote the planned redevelopment and use of urban land, renovate urban functions, improve the living environment and increase the public interest. Huang (Huang, 1984) and Shih (Shih, 1997) indicated that the purposes of urban renewal can be categorized into four dimensions while each purpose is correlated with mutual impact, including: (1) Essential purpose: Improve living environment and public facilities, eliminate public safety problems resulting from slum areas, increase residential supply and renew urban functions; (2) Economic purpose: Revitalize economics by attracting investors, create employment opportunities, increase tax revenue and improve financial structure of local government and efficiency of public investment; (3) Social purpose: Provide employment opportunities, improve living quality of low-income residents, eliminate the social issues derived from poverty and fulfil principles of social fairness; (4) Political purpose: Highlight the outcome of government policies, improve urban competitiveness, recall community awareness in residents, and promote public participation. Carmon (Carmon, 1999) further indicated that benefits created by urban renewal can be categorized into the following: (1) preventing disadvantaged groups from segregation; (2) taking consideration of economic development and social justice; (3) progressive and soft solutions; (4) promoting public-private cooperation; (5) different areas adopting differentiated processing methods and other strategies. Wu (Wu, 2001) suggested that urban renewal aims to improve urban functions and living quality. The areas of urban renewal units will gather for the homogeneity of urban functions and further result in the centralized effect of spatial distribution. The literature mentioned above show that the purpose (or benefit) of urban renewal is to improve the essential environment, stimulating economic development, and takes consideration of social public interests. Hence, this study classifies the outcome of urban renewal projects into economic, environmental and social dimensions, which attempts to select quantitative indicators from the urban renewal process.

1.2   Performance Assessment

All the organizations have business goals and require some information to determine if the organizations are progressing on the right track. Performance assessment refers to the systematic process where an organization intends to accomplish certain goals, plans how to accomplish the goals and assesses whether or not the organization has accomplished the goals. Drucker (Drucker, 1998) defined performance assessment as the management function in essence. Performance assessment helps understand the degree of execution of the project and determines corrective countermeasures when the project deviates from the planned direction. The establishment of an assessment system will guide the action takers in decision making and behaviours prior or during the activities, thereby reconciling the objectives endeavoured and the organizational goals. Szilagyi (Szilagyi, 1984) defined performance as the composition of two factors, namely efficiency and effectiveness; where effectiveness refers to the level of goal accomplishment while efficiency refers to the output/input

ratio for measurement. In sum, performance assessment can be regarded as a mechanism of establishing certain standards and control for organizations to accomplish their goals, and is an economically efficient method that emphasizes expenditure review, productivity increase and reduction of waste of resources. Such methods will help decision-makers understand in-depth how to improve decisions and comply with the establishment of project goals. Hence, this study intends to assess the performance of urban renewal projects in Taipei City. Some common performance assessment methods include Ratio Analysis, Regression Analysis and Data Envelopment Analysis (DEA) (Thanassoulis, 1993); Thanassoulis and Boussofiane et al (Thanassoulis and Boussofiane et al., 1996); Sun (Sun, 2004). The characteristics, context, pros and cons of each method are discussed as follows:

(1) Ratio Analysis

Thanassoulis and Boussofiane et al (Thanassoulis and Boussofiane et al., 1996) proposed ratio analysis as a more traditional assessment method. The production efficiency derived from ratio analysis method is biased towards single-use elements and neglects the contribution of other input elements, which will easily result in decision errors and resource waste. The difficulty in measuring efficiency when taking into consideration multiple inputs and outputs lies in the lack of universal standards of output comparisons. The drawbacks of the method are described as follows: (1) Sole performance of the relationship between single input and single output. (2) It is difficult to obtain the overall performance from the decision making unit when measuring all performance indicators on the different performance levels. (3) It is difficult to formulate efficiency standards and the efficiency could not be confirmed for different units. (4) The use of multiple variables requires use of weights while the weighted ratios in variables could be more subjective and lack objective basis.

(2) Regression Analysis

Regression analysis is an ex-post analysis method that objectively determines the weighted relationships between input and output factors; nonetheless its main limitation lies in its inability to process multiple outputs. However, land use planning is so complex that the feasibility of such analysis is constrained due to the massive factors (output) that should be considered. Furthermore, the result of regression analysis emphasizes the overall conditions of the majority, which will neglect the specific conditions of individuals. The drawbacks of the method are described as follows: (1) Sole performance of the central trend of regression without identifying between efficient variables and inefficient variables. (2) Only one output is permitted to be evaluated. (3) The result is an average performance of efficiency value rather than the best relative performance. (4) The coefficient value of the independent variables could not be compared.

(3) Data Envelopment Analysis (DEA)

Data Envelopment Analysis refers to a linear programming-based method, a relative efficiency method that measures Decision Making Units (DMU) with multiple inputs and multiple outputs (Thanassoulis, 1993). DEA applies a production boundary as the foundation of efficiency measurement and yields the production boundary using mathematical models without presetting the nonparametric approach of production functions. DEA can explicitly identify the relative inefficient units and is substantially more precise than the traditional regression analysis. Another advantage of DEA is that the boundary value and the objective standard are

less likely affected by the correlation between inputs and outputs or the influence from multicollinearity (Thanassoulis, 1993).

(4) Comparison of Assessment Method

Ratio analysis can only be used to assess the relationship between single input and single output. Regression analysis estimates the function relation between multiple inputs and a single output. DEA can concurrently take the efficiency relationship between multiple inputs and multiple outputs into consideration. In addition, DEA does not need default weights for input or output. Due to the aforementioned advantages, DEA is considered to be the most feasible and easiest method for assessing relative efficiency, particularly for the environment of multiple inputs and outputs. In recent years, a number of studies related to environmental efficiency assessment identified DEA as a more appropriate analysis method (Barnes, 2006; Bosetti and Buchner, 2009). Because the multiple inputs and multiple outputs of urban renewal projects are attributed to different measurement units, which are in compliance with the DEA characteristics, this study assesses the objects using the DEA method.

1.3   Urban Renewal Performance Assessment

U.S. real estate research companies and other related urban departments suggested the purpose, types, process, and discussion of urban renewal projects in "Evaluating local urban renewal projects: a simplified manual" in 1975. The purpose of assessment is to change current urban conditions, review the fees required for renewal projects, determine the bodies of urban renewal, and assess the effectiveness of the renewal project. Additionally, Figure 1 shows the Urban Renewal Project Assessment Flowchart. The first step is to choose assessment projects, influence factors and further search the relevant information. The second step requires complete information of macro urban and neighbourhood areas to examine the urban renewal projects under the different levels and experience from the state, city to the neighbourhood. In the third step, multiple alternatives are designed to evaluate the "cost and benefits" of the solution in order to validate the feasibility of a project. Finally, multi-cooperation and decision making needs to be carried out to formulate relevant action plans.
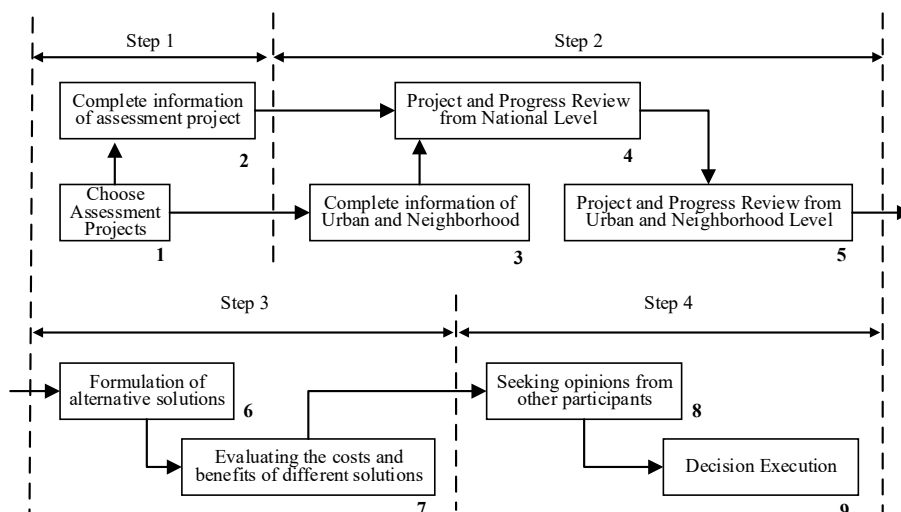

Figure 1. Urban renewal project assessment flowchart

Chang (Chang, 2000) suggested that the context of urban redevelopment consists of characteristics in essential environment, social, economic and political dimensions. The study developed a systematic framework with 12 objectives and 36 indicators via the Delphi technique and used the Fuzzy Hierarchical Analysis method to attain the weights of the framework. The results show that the assessment indicator of the economic dimension weighs the highest, followed by the environmental dimension, the social dimension, and finally the political dimension. Lum and Sim et al. (Lum and Sim et al., 2004) analysed the government policies advocated in Singapore and found that an urban renewal strategy could cause unpredicted and opposite results, i.e. the omission of environmental characteristics and acceleration of economic decay. Hence, the advocacy of urban renewal policies not only needs to assess policy effectiveness but also confront adverse impacts. Lee and Chan (Lee and Chan, 2008) assessed urban renewal in Hong Kong by questionnaire survey and a Delphi Hierarchical Analysis. The study proposed the key factors for urban renewal projects from the dimensions of sustainable development, i.e. economic, social and environmental dimensions, and attained the urban renewal performance assessment system. Chou (Chou, 2009) established a hypothesis and used the urban renewal projects in Taipei City to examine whether the property complexity, market value and government measures will influence the completion time of urban renewal. The regression analysis method was used and the variables considered in the study includes the number of squatter houses, post-renewal property value and bulk reward ratio etc. It is one of the few studies that use a quantitative method to examine the effectiveness of urban renewal.

Urban renewal is becoming the primary market for land development in Taiwan. Though the majority of academic research has emphasized on the discussions of policies and legal systems, few studies have examined the performance of urban renewal from the perspective of investment in renewal resources. This study therefore adopts the DEA method for multiple decisions by using various urban renewal units with multiple inputs and outputs to assess the performance of urban renewal. The application of the DEA based performance assessment method on the feasibility of urban renewal development can be used for calibration of an urban development strategy and as reference tools for the government in review of decisions to approve bulk rewards for urban renewal projects.

2.   RESEARCH DESIGN

2.1   Objects

The study comprised the 221 urban renewal projects approved by Taipei City between November 1998 and February 2014 from the Urban Renewal Portal of Construction and Planning Agency, Ministry of the Interior (CPAMI). However, due to the limited number of right transfer projects implemented and incomplete data, 79 Decision Making Units (DMU) were applied with DEA after screening and deducting. It is worthy to mention that according to the empirical rules on DEA use proposed by Golany and Roll (Golany and Roll, 1989), the number of DMU assessed should at least be twice the sum of the inputs and outputs. Because the study selects 11 input

and output variables and the number of the valid DMUs with complete data are 79, the aforementioned empirical rule was therefore satisfied.

2.2   Method

Urban renewal is a decision issue that comprises multiple objectives of mutual conflicts. The government has to take multiple objectives into consideration currently including the variables of economic, environmental and social dimensions. Hence, the study suggests that the renewal agency of the government should concurrently take its expected objectives and reasonable profit for the developer into consideration during the review process. Based on the characteristic mentioned above, the DEA method which Charnes and Cooper (Charnes and Cooper, 1978) established is suitable for the performance measurement of the multi-input and multi-output urban renewal projects. This study thus applies a CCR(Charnes-Cooper-Rhodes) model and BCC(Banker-Charnes-Cooper) model in DEA as the efficiency measurement models. Using those models to determine DMU corresponding point lies efficient frontier above. Because CCR point on the efficient frontier means technology not only effective, but also the scale efficiency.

CCR model merely yields a total efficiency value and lacks the complete information. Hence, the study applied the BCC model to divide the total efficiency value into pure technical efficiency and scale efficiency. The information can be further used by the government to suggest the developer to adjust the direction and input extent of resources on the review phase. Moreover, the study used the efficiency values of different units derived from DEA to carry out the sensitivity analysis which aims to understand the impact of increase or decrease of input factors on relative efficiency.

With regards to input and output oriented model configuration, this study evaluates the efficiency by using "Input Orientation" and "Standard model" (Banker, 1984) mainly because the input variables can be better controlled during the urban renewal process. Excessive inputs can be adjusted downward to increase execution performance. On the other hand, the efficiency of urban renewal aimed at the current output level and how to get input costs can be minimized. Therefore, it is more applicable to apply input oriented evaluation of efficiency.

2.3   Selection of Performance Assessment Indicators

To effectively control assessment factors that could possibly affect urban renewal development, any relevant factors that affect the performance of DMU should be extensively listed in the assessing factors at the beginning when defining the influential assessment factors. These factors consist of controllable and non-controllable environmental factors while the screened input and output factors must be able to explain the impact of each factor on efficiency logistically. Hence, the relationship between factors can undergo analysis of correlation for validation.

2.3.1   Preliminary Output Screening

To promote the planned redevelopment and use of urban land, the legislative purposes of Urban Renewal Act, with an explicit definition in Article I, are to revitalize urban function, improve living environments and

increase public interests. This study classifies the aforementioned three objectives into economic, environmental and social dimensions as the assessment standard based on the content of the literature review. Regarding the output factor, the post-renewal value of real estate is used as the proxy variable of the economic dimension, and the open space and sidewalk created by urban renewal projects is used for the proxy variable of the environmental dimension. Finally, the area provided for the public facilities and resident relocation is used as the proxy of the social dimension (Table 1).

2.3.2   Preliminary Input Screening

According to the selection principles of the DEA indicator, input factors refer to the resources that contribute to the output. For the developers, factors that affect the willingness to invest include base conditions, property condition and development profits. This study uses eight types of influential factors as the input variables which includes land area of renewal unit, ratio of public land area in renewal unit, floor area ratio, proportion of the agreed owner to participate in urban renewal, construction costs of buildings, urban renewal schedule, management techniques and bulk reward for urban renewal project given by the government (Table 1).

2.4   Relevant Analysis

The application of the DEA model requires a positive correlation between the selected inputs and outputs to comply with the isotonicity requirement. Pearson correlation emphasizes on processing the linear correlation between two random variables. Hence the study applies Pearson's correlation analysis method to validate the final selection of input and output factors. This study discovers that all the factors reach a positive correlation, among which the area of renewal units is positively associated with the social dimension with a highly significant value. It implies that the greater the land area of renewal units is, the more likely the existing residents can be well relocated.

2.5   Input / Output Selection

Table 1 shows the determined input and output variables of the DMU in this study after the Pearson's Correlation Analysis. The meaning of each variable to urban renewal projects were described as follows.

Table 1. Input and output variables of the DEA

Variable	Definition	Unit
Input		
Base Condition		
1. Land area	Area of renewal unit	m^2
2. Public land ratio	Ratio of public land area in renewal unit	%
3. Development intensity	Floor area ratio	%
Input of Developer		
4. Integration degree	Proportion of the agreed owner to participate in urban renewal	%
5. Construction costs	Construction costs of buildings	Million NT$
6. Urban renewal schedule	time required for renewal	Year
7. Management techniques*	Management costs indicated in project	Million NT$
Input of Government		
8. Ratio of renewal reward	Bulk reward approved by government	%

Variable	Definition	Unit
Output		
Economic Dimension		
1. Post-renewal value	Real estate value after renewal	Million NT$
Environmental Dimension		
2. Open space and Sidewalk	Area of open space and sidewalk created	m^2
Social Dimension		
3. Public facilities and residents relocation **	Area provided for public facilities and relocation use	m^2

* The profit that should be obtained by implementer due to the creativity proposed, management techniques and risk taking; where higher profit implies greater input and higher renewal efficiency.

** Social welfare facilities for community use, including activities' center, libraries and so on, as well as the relocation area provided for the current residents.

3.   EMPIRICAL RESULTS

3.1   Relative Efficiency Analysis

The overall efficiency of the urban renewal projects is derived from the CCR model. The average efficiency value of DMUs is 0.99. There are 64 urban renewal projects with a total efficiency value of 1, which accounts for 84% of the total DMUs population. Norman and Stocker (Norman and Stocker, 1991) specify this kind of DMU as the "Robustly Efficient Units". The total technical efficiency, pure technical efficiency and scale efficiency of the projects are 1, which suggests the full utilization of inputs by these projects without waste. The appropriate scale will contribute to the maximum output for economy, environment and society. The aforementioned urban renewal projects with efficiency values of 1 are distributed as following: 1 projects in Wanhua District, 2 projects in Shilin District and Datong District respectively, 3 projects in Beitou District, 5 projects in Xinyi District and Neihu District respectively, 6 projects in Daan District and Zhongzheng District respectively, 7 projects in Zhongshan District and Songshan District respectively, 8 projects in Nangang District, and 12 projects in Wenshan District. As for the other kind of DMU proposed by Norman and Stocker (Norman and Stocker, 1991), the total efficiency values which are less than 0.9 are defined as Distinctly Inefficient Units. There are 3 projects with a relatively low total efficiency value of 0.89 on average and the distribution of these projects are mainly located in Datong District and Xinyi District.

Table 2 compares the base characteristics of the urban renewal units between the efficient DMUs and inefficient DMUs. This study shows that DMUs with high efficiency have greater land area, which accompanies a higher floor area ratio than inefficient DMUs. Nonetheless, the public land ratio shows no difference between the two kinds of DMU. The result indicates that the renewal unit with a greater land area, higher floor area ratio has more likelihood to execute an efficient urban renewal project while the proportion of the public land area of the renewal unit does not have direct impact on the efficiency of urban renewal execution.

Table 2. Comparison table of the DMU on base characteristics

Unit characteristics (unit)	Efficiency classification	
	Robust efficiency	Distinct inefficiency
Administrative district	Focusing on Wenshan district	Focusing on Datong district

Unit characteristics	Efficiency classification	
(unit)	Robust efficiency	Distinct inefficiency
Land area (m^2)	3,321	3,092
Public land ratio (%)	0.2	0
Development intensity (%)	333	326

In the urban renewal process, the developer invests in integration, construction, time and management techniques while the government induces the private-sector to implement an urban renewal project and put into other resources through bulk reward. This study compares the input characteristics between the efficient DMUs and inefficient DMUs. Table 3 shows that DMUs with higher efficiency feature higher investment in building cost and higher bulk reward approved by government. In other words, higher costs invest in building construction and higher bulk reward will create more efficiency of urban renewal. On the other hand, a higher proportion of the agreed owners to participate in urban renewal and higher costs in management techniques do not necessarily result in urban renewal with high efficiency. As Chung Wen (Chung, 2012) pointed out, developers must be able to reduce integration costs to increase profit. Finally, the renewal schedule of the project with high efficiency is six years, which is three years shorter than those with low efficiency on average. The result indicated that the longer the schedule of the urban renewal is, the lower the performance will be.

Table 3. Comparison table of the DMU on input characteristics

Unit characteristics	Efficiency Classification	
(unit)	Robust efficiency	Distinct inefficiency
Integration degree (%)	64	67
Construction costs (million NT$)	970	906
Urban renewal schedule (year)	6	9
Management techniques (million NT$)	193	263
Ratio of renewal reward (%)	42	35

For the benefit created by urban renewal in the economic, environmental and social dimensions, Table 4 shows that DMUs with higher efficiency will generate a higher output than those generated by the DMUs with lower efficiency. The result indicates that urban renewal projects with higher performance can better create overall benefits of urban renewal.

Table 4. Comparison table of the DMU on output characteristics

Unit characteristics	Efficiency Classification	
(unit)	Robust efficiency	Distinct inefficiency
Post-renewal value (Million NTD)	2,861	2,679
Open space and Sidewalk (m^2)	858	729
Public facilities and residents relocation (m^2)	850	790

3.2　　Slack Variable Analysis (SVA)

For the DMUs with an overall technical efficiency value of less than 1, this study further conducts the Slack Variable Analysis to understand the improvement amount between inputs and outputs of the inefficient urban renewal projects. Because the BCC model used in this study is input oriented, if the improvement direction shows on the input side, the amount of inputs should be reduced; on the contrary, if the improvement direction shows on the output side, the amount of outputs should be increased. The improvement ratio of the inputs and output is categorized in Table 5.

Table 5 shows that among the input variables, public land ratio shows the greatest extent of input reduction, followed by the reduction in integration degree, urban renewal schedule and management techniques. The result suggests that to achieve relative efficiency and shorten the overall renewal schedule, it is better to choose a renewal unit with small public land and avoid consuming excessive costs on integration and management techniques, which is usually the typical type of increased marginal cost, to pursue the high integration degree and low risk.

With regards to output variables, the improvement factor first focuses on the social dimension, followed by the environmental dimension and eventually the economic dimension. The result shows that the renewal results should strengthen the output of the social dimension and environmental dimension to meet the objectives of public interests and improvement of the living environment. This result is similar to Hemphill, Berry and McGreal (Hemphill et al., 2004), whose study found measurable indicators of sustainable urban renewal. That urban renewal should focus on social factors, community and conservation of natural resources.

Table 5. Improvement ratio of the inputs and output.

Category	Improvement direction	Variables	Improvement ratio (%)
Input	Reduce	Land Area	0.31
		Public Land Ratio	34.9
		Development Intensity	0.49
		Integration Degree	4.72
		Construction Costs	0.68
		Urban Renewal Schedule	4.12
		Management Techniques	3.17
		Ratio of Renewal Reward	1.97
Output	Increase	Post-Renewal Value	0.58
		Open Space and Sidewalk	3.75
		Public Facilities and Residents' Relocation	6.13

3.3   Sensitivity Analysis

The study conducts a sensitivity analysis to explore the influences of the increase or decrease in input on relative efficiency. Because the study uses the input oriented approach for the performance assessment, the sensitivity analysis is conducted from the aspect of input dimensions and explores the changes of the efficiency ratio. Table 6 shows that the deletion of individual factors will not change the overall efficiency substantially in general. However, deletion of the development intensity (floor area ratio), bulk reward and land area will lead to lower efficiency values. The result implies that the original conditions of urban renewal units, i.e. the floor area ratio and land area, are more sensitive than other variables. In addition, endeavouring to receive a bulk reward in the urban renewal process is also sensitive to the renewal outcome. The three variables are therefore regarded as the major factors affecting urban renewal benefits, which helps developers to decide whether to carry out renewal projects and endeavour to receive a bulk reward. Governments can use this type of bulk reward of public resources to create and ensure profit for private investment (McGuirk, et al., 1996).

Table 6. Sensitivity analysis of input variables

Deleted variable	Ratio change (%)	Total Average Efficiency value
No Deletion	0	0.99

Land Area	2	0.98
Public Land Ratio	0	0.99
Development Intensity	4	0.96
Integration Degree	0	0.99
Construction Costs	0	0.99
Urban Renewal Schedule	0	0.99
Management Techniques	0	0.99
Ratio of Renewal Reward	3	0.97

4.   CONCLUSION AND SUGGESTIONS

4.1   Conclusion

This study explores the correlation between input resources and output benefits of urban renewal by using 79 valid samples of urban renewal projects in Taipei City. The DEA method is used to establish the performance assessment model and the efficiency value is derived, which not only allows the developer to evaluate the feasibility of urban renewal development, but also uses the reference tools for the government to review the amount of bulk rewards for the urban renewal projects. The conclusion of the study is drawn as follows:

(1) This study finds that compared with inefficient DMUs, the highly efficient DMUs feature greater land area, higher floor area ratio, higher investment of construction costs, and endeavouring for higher bulk rewards. In addition, the result of sensitivity analysis also supports that land area, floor area ratio and bulk reward are sensitive factors that affect efficiency. The aforementioned result indicated that the urban renewal unit with greater land area and higher floor area ratio, plus proper input of construction costs and endeavouring of bulk reward during the urban renewal process is more likely to result in an efficient urban renewal project.

(2) With regards to the output of urban renewal benefits, the study finds that the efficient urban renewal project tends to have a higher output value for the economic, environmental and social dimensions, which indicates that there is a positive correlation between the execution performance and the overall benefits created by urban renewal. In cases where the developer inputs resources effectively, they will be able to increase the value of real estate, the quality of open space, sidewalk, and public facilities as well as the relocation of current residents, which further promotes public interests.

(3) The improving factors of the inefficient urban renewal projects include the reduction of the public land ratio, integration degree and urban renewal schedule, which suggests that it is better to choose an urban renewal unit with small public land and avoid consuming excessive integration costs to shorten the overall renewal schedule. Additionally, the output of the social and environmental dimensions should be increased first to reach the relative efficiency.

4.2   Suggestions

This study proposes the following suggestions to promote the execution performance of urban renewal from the perspective of developer and government agencies.

(1) From the view point of the private sector, to enhance intensity of development and increase the benefit of urban renewal, developers may choose a base with larger land area and higher floor area ratio when defining the renewal units or assessing whether to carry out the renewal development. Nonetheless, excessively high public land ratio and integration degree could decrease the implementation power of the developer and increase the time cost respectively, which further results in decline of the execution efficiency of the renewal projects.

(2) From the view point of the government, though bulk reward will increase developers' intentions to invest in urban renewal, the study finds that the benefits of bulk reward on the environmental and social dimensions are insignificant, but increase the post-renewal value of real estate significantly. Hence, it is suggested that the approval of bulk rewards should emphasize on the environmental and social dimensions with specific and clear mechanisms, which makes the developer provide the equivalent open space, public facilities, sidewalk, and relocation of existing residents.

(3) It is suggested that future studies may apply the Tobit regression model to conduct an analysis based on the efficiency value yielded from the DEA and explore the influence of each input factor on the efficiency value. In addition, future studies are suggested to further provide support for the literature on social costs of urban renewal, property structure, and public-private collaborative development with more exact description.

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Research on Smart Community Planning of Yishanwan, China towards New Urbanization

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Abstract: Under the guidance of the China national development policy of new urbanization, this research explores the approach of how to promote the development of new urbanization through the construction of smart community by taking the community planning of Yishanwan, Jiangxia District, Wuhan as an example. Based on the practical experience of the planning and construction of a smart city, a general framework of smart community planning of Yishanwan is put forward in this paper. The framework consists of five-layer components, which are the base layer, sharing layer, application layer, service layer and portal layer. An information center and a security system are designed to conduct the integration of the five layers. With the instruction of the framework, it is expected to achieve four targets: the construction of the infrastructure, the establishment of a sharing platform, the research and development of an application system and the development of a service portal. With the achievements implemented, the smart Yishanwan community will be founded.

1. BACKGROUND AND DEMAND ANALYSIS

1.1 Background of Smart Yishanwan planning

In the "China National Planning of New Urbanization (2014-2020)" which was published in March 2014, it claims to promote the development of green city, smart city, humanistic city and to improve the inner equality of the city comprehensively. It is obvious that the construction of smart city has escalated into a national strategy and become a significant method of promoting new urbanization and achieving sustainable development (Xi and Zhen, 2014). In the chapter of "promoting the construction of smart city", it claims to coordinate the physical resources, informational resources and the intellectual resources of urban development, and to facilitate the innovative applications of new generation information technology, such as the internet of things, big data and cloud computing, so that they can be integrated with the economic and social development effectively. In the meantime, it also proposes to promote the trans-departmental, trans-sectoral and trans-regional sharing of government affairs' information and collaboration of business, and to enhance the socialized exploitation and application of informational

resources, and generalize intelligent information applications and new information service patterns. With all those efforts mentioned above, it is expected to achieve the informatization of management of urban planning, the intellectualization of infrastructure, the facilitation of public service, the modernization of industrial development and the refinement of social governance. Finally, it emphasizes the importance of strengthening the security capacity of a city's vital information system and pivotal information resources. In the chapter of "carrying out pilot demonstration program", it claims to go on with the pilot program of promoting a creative city, smart city and low carbon city.

In recent years, the planning and construction of smart city has become one of the key directions of Chinese urbanization development. From January 2013, Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD) has selected two groups of 193 cities (districts, counties, towns) to carry out the national pilot demonstration program of smart city, and the selection work of a third group of national pilot demonstration cities is under way. On the one hand, those major initiatives taken by MOHURD meet the needs of the future development of new urbanization. On the other hand, it is an inevitable consequence of the informatization development at present in China.

According to the latest "statistical report of status of China Internet network development" published by China Internet Network Information Center (CNNIC), as of December 2014, the amount of Chinese net citizens is 649 million, among them, there are 557 million mobile phone net citizens, and Chinese Internet penetration is at 47.9%. It is quite encouraging that the perspective of China's informatization development is very promising in view of the nearly 10 years of statistical data and the level of informatization increasing year by year (*Figure 1*). But compared with some developed countries in the world, there is still much more room to improve.
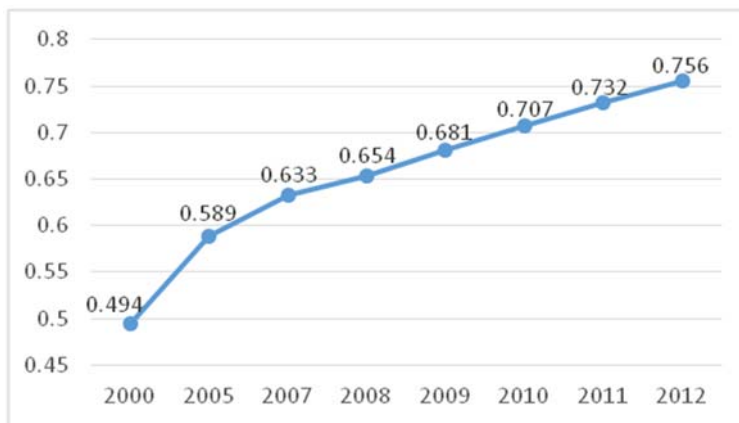

Figure 1. Change of Informatization Development Index of China (IDICN)

Data source: National Bureau of Statistics of the People's Republic of China,

http://www.stats.gov.cn/tjzs/tjsj/tjcb/dysj/201405/t20140506_549559. html

Additionally, among the reports of the 18th national congress of the Communist Party of China, the authorities have made an important policy of promoting the synchronous development of informatization, new industrialization, agricultural modernization and new urbanization, which makes the construction of informatization a national strategy. It is considered as a necessary measure to keep up with the development trends of the era. China has stepped into the middle and later period of industrialization, only

the profound fusion of industrialization and urbanization can constantly promote the process of socialist modernization. In the meantime, new urbanization and agricultural modernization should coordinate with each other, since both of them are the breakthrough of the development of rural areas and agriculture, and they have to rely on each other and promote each other. If only urbanization is relied on, and the importance of agriculture modernization is neglected, it will be difficult to change the condition of rural areas fundamentally. Furthermore, in the process of the development of new industrialization, new urbanization and agriculture modernization, it is informatization that can facilitate and lead them (*Figure 2*). Only if we follow the general developing trend of the information society, think on the basis of the thought pattern of informatization and move along the development approach of informatization, can we advance and guarantee the development of new industrialization, new urbanization, and agricultural modernization. With all those efforts, we can realize the leap-forward in development of social productivity, achieve the goal of building a well-off society comprehensively and realize the construction of a beautiful China.
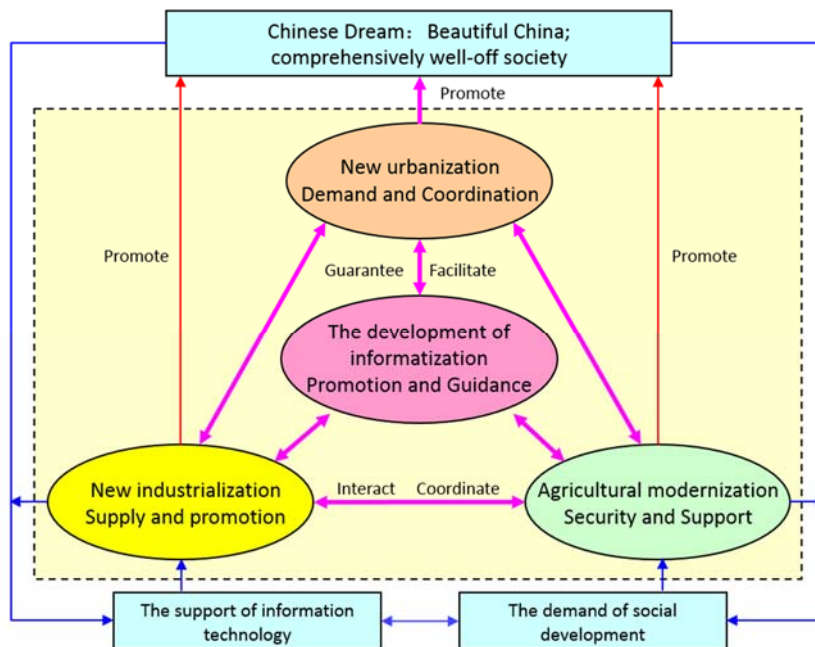

Figure 2. The synchronous development of informatization, new industrialization, agricultural modernization, and new urbanization

1.2   Demand analysis of Smart Yishanwan

The inevitable consequence of the profound fusion of informatization, new industrialization and new urbanization is the formation of smart city (Mao and Li, et al., 2013; Li , 2014). Smart city is based on the Internet of things and cloud computing and its core idea is to form the Internet of things through equipping every object of urban life with sensors. The Internet of things is integrated by super computers and cloud computing, thereby implementing the integration of a digital city and city systems (Li and Shao, et al., 2011). The construction of smart city can not only provide more efficient services for residents by improving the infrastructure, but also will motivate the advance of the innovative ability of society and economy, integrating the concept of sustainable development into the development of cities (Chourabi and Nam, 2012).

At present, in the process of vigorously promoting China's new urbanization, the construction of smart city will contribute from different aspects, such as technology innovation, infrastructure, economic transformation, social management and so on (Xi and Zhen, 2014). Smart community is further a concrete embodiment of the structure of smart city and becomes a basic composition unit of a smart city (Jiao, 2013). Smart community has inherited the construction experience of smart city, which will apply to many kinds of up-to-date information technology comprehensively on the community scale, exploit many kinds of information resources and establish a community public data resource center, so as to achieve intelligence of community management, community governance and community social service.

Yishanwan community is located in Jiangxia District, Wuhan, Hubei Province, China (*Figure 3*). As it plans the community space layout and industrial layout in the new comprehensive planning, it also urgently calls for the development of community informatization. It believes that only deepening the application of information technology in all fields of new community, fully excavating, real-time integrating and effectively allocating the community resources can realize the integration of urban and rural areas' overall development. Therefore, under the background of the synchronous development of informatization, new industrialization, agricultural modernization and new urbanization, the construction of Yishanwan smart community towards new urbanization is to follow both the trend of the era and the approach which most conforms to the local developing expectations. According to the experience of the construction of smart city, the demand of building Yishanwan smart community is embodied in four aspects: the construction of informatization infrastructure, informatization management, informatization services and the construction of informatization mechanisms.

Figure 3. The location and relationship of Jiangxia district and surrounding cities

2.   GENERAL FRAMEWORK AND MAIN TASKS

2.1   The general framework of Smart Yishanwan

According to the demand of informatization development of smart community, the general framework (*Figure 4*) of Smart Yishanwan consists of five-layer components, including base layer, sharing layer, application layer, service layer, and portal layer. An information center and a security system are working on the integration of the five layers. The framework can be summarized as a project of "Six Ones", that is organizing one information center, building one base layer (a set of infrastructure), one sharing platform, one application and service system, one information portal and one security system.
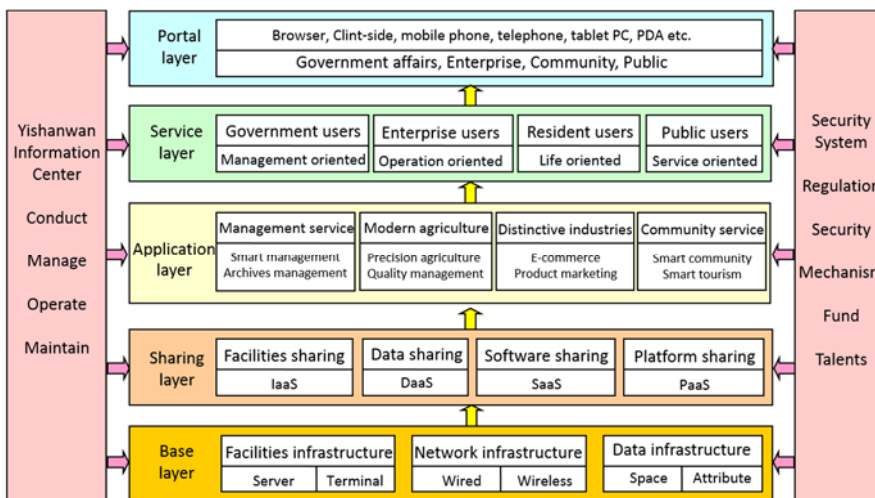

Figure 4. The general framework of Smart Yishanwan community

(1) The information center. A professional institution is required to be in charge of the kinds of work of a Smart Yishanwan community, which includes project planning, organizing and implementing, constructing and managing, and operating and maintaining. Taking account of the scale of Yishanwan community and the efficiency and benefit to operate and maintain the center, it is appropriate to authorize the information center of Jiangxia District to undertake the task.

(2) The infrastructure layer. This is required to sense, collect, transmit, store, manage and update the community data of Smart Yishanwan, and realize the interconnection and interwork of diverse application system data, as well as to provide data service and support for the upper layer through intelligent processing including data connecting, data evolving and data maintaining.

(3) The information sharing layer. This aims at gathering different kinds of intelligent application services and establishing application oriented public service through the middleware of diverse software. As the foundation of building all sorts of typical intelligent applications of Smart Yishanwan, the sharing layer will realize the sharing of all resources of a Smart Yishanwan community including facilities, data, software, platform and so on.

(4) The application and service layer. It works directly for users of different levels and terminal equipment, and provides specific intelligent applications and services for different types of users of Smart Yishanwan

community, including four aspects which illustrate the useful effect of the informatization and the synchronous development of informatization, new industrialization, agricultural modernization and new urbanization, that is government affairs management service, development of modern agriculture, development of characteristic industries, and smart community service.

(5) The community portal. This integrates the applications of government affairs, enterprises, community and the public in the form of a portal, which will be published by means of browser, client-side, smartphone, network TV, tablet PC, and PDA etc., providing service and support for government affairs, enterprises, community and the public of the service layer.

(6) The implementation and security system. It involves the regulation, standard, security, fund and talents, and therefore should play a part throughout the whole process of data sensing, data transmission, data storage, data processing, data display and data application.

2.2 The main tasks of Smart Yishanwan

The main tasks of Smart Yishanwan consist of the construction of infrastructure, the establishment of the sharing platform, the research and development of an application system and the development of a web portal. The four main tasks can be divided into eight aspects which refer to facilities infrastructure, network infrastructure, spatial data infrastructure, information sharing platform, government affairs management service, development of modern agriculture, development of smart community and smart community portal.

(1) Facilities infrastructure. The fundamental facilities are the base of the whole information system. In the first place, it is a pre-requisite to guarantee that each link is able to employ a computer to complete the basic work in the whole information system, then it is required to establish a server which will deal with a variety of businesses and the corresponding storage system, so as to implement the hardware system based on the network architecture. In the end, a network system which connects all the business terminals, servers and storage devices comes into being, achieving the informatization and networking of all businesses. We finally design the facilities infrastructure of Smart Yishanwan community which includes four categories: the basic server, the network storage, the computer terminal and the mobile application terminal.

(2) Network infrastructure. The composition of the network infrastructure of Smart Yishanwan mainly includes two parts which are the information sensing facilities and information transmission facilities. Information sensing facilities are the facilities and technology for information collection, which are located in the front-end of the informatization system, such as remote sensing technology, radio frequency identification (RFID), Global Navigation Satellite System (GNSS) terminal, sensor and video capture terminal, etc. Information transmission facilities mainly refer to wired and wireless networks, including fiber optic backbone network, wireless communication network, WLAN (Wireless Local Area Networks) in key areas and related servers, network terminal facilities and technology. Essentially, the information transmission facilities are the internet of things' system including a core network, access network and extended network, which consists of a sensor network composed of ubiquitous new sensing facilities and next generation internet. It is able to sense and transmit information of components, facilities, equipment, and

humans in real time.

(3) **Data infrastructure.** The foundational database system of basic space, industries, economy and population should be set up based on geospatial information. According to the concept of "One Map", it will be beneficial to integrate all sorts of economic and social development data and establish one data center of Smart Yishanwan which can uniformly provide visualized decision analysis and a data sharing service for the typical applications of the Smart Yishanwan community. On the basis of related regulations of building spatial data infrastructure, taking the present development situation and the demand of Yishanwan informatization as a starting point, and following the trend of future development of information technology at the same time, the data infrastructure of the Smart Yishanwan community will be composed of a series of subsystems including data collection, database management, data access, system management, data backup, staff management, interaction webpage and data export, etc.

(4) **Information sharing platform.** The development of various industries and businesses has a strong demand for the exchange and service of public information resources. To meet the demand, an open and shareable supply service platform should be constructed, realizing the integration of a dynamic information service for the Smart Yishanwan community, and managing, sharing, exchanging all sorts of public information of community management, community production and life. The sharing and service platform of Smart Yishanwan is the foundation and key to achieve smart community, and the fundamental goal of constructing this platform is to adopt a uniform data exchange format realizing data exchange and information sharing between different information systems. On the basis of the achievement of the above goal, it can be guaranteed that each application system will be able to be integrated into one basic platform which is easy to integrate, easy to maintain and extensible, making it convenient to upgrade the business process in order to satisfy new business requirements.

(5) **Government affairs management service.** To improve the intelligence level of office working, serving and decision-making of Yishanwan community government and each functional department, and form an efficient, agile and convenient new government realizing smart government affairs management, we should make full use of the internet of things, mobile internet and technology of data excavation and knowledge management etc. Through the establishment of smart government affairs, the governance pattern will be transformed from "management oriented" to "service oriented", improving the efficiency of handling the official business of the Yishanwan community government. It will also improve governance transparency, strengthen the cultivation of an incorruptible government and improve the governing capacity and the ability of scientific decision-making. Meanwhile, it plays an important role in promoting policy advocacy and public education.

(6) **The development of modern agriculture.** The informatization development of Yishanwan modern agriculture takes the demands of Yishanwan as a starting point and accelerates the profound fusion of informatization and agriculture. The aim of modern agriculture is to develop one kind of agriculture which is land-intensive, technology-intensive and ecologically-circular, to promote the deep processing of agricultural products and strengthen quality management. Therefore, the core idea of modern agriculture is to promote automatic production, industrialized operation and brand marketing of agricultural products, in order to improve comprehensive productivity, competitive capacity and sustainable developing capacity of

agriculture, and enhance the vitality of economic development as a result.

(7) The development of smart community. To promote the construction of the smart community of Yishanwan, it needs to integrate government a web portal with a service hotline. Based on the establishment of a community residential service hotline, residential portal and community information service station, we build the smart community connected by a convenience card, government affairs data center or other public service platform. The development of a smart community will provide lots of services for community residents including convenient information inquiry, social insurance, on-line education, tele-medicine, smart culture, and so on, as well as a change of life style, learning style, and working mode gradually. It will enhance the informatization level of community life in every way, forming a high quality, convenient, happy and comfortable living environment.

(8) The development of a community portal. Supported by the new generation of information technology, the web portal of the Yishanwan community will integrate various government resources and various application services in accordance with the unified planning, unified standard and unified architecture, building a smart community portal with open information, efficient service, a good user experience and accessibility for the mobile intelligent terminal. With the above efforts, the portal will be able to achieve the function of information service provider, e-government affairs, online service and interaction between government and the public, creating a one-stop and comprehensively intelligent service platform. We attempt to realize three goals with the construction of the web portal: all coverage of information services, one-stop service of government affairs and a well-found interaction system between government and the public.

3.   INFORMATION SHARING AND APPLICATION

3.1   Information sharing platform of Smart Yishanwan

The information sharing platform of the Smart Yishanwan community can be supported by SOA (Service Oriented Architecture) and cloud computing. With the support of such technology, we construct a "service center" applying the hierarchical structure and assemble all kinds of "atomic services" of the center through a "service factory" so as to create certain functional services which meet the actual demand. And these functional services will be published based on the mode of the "service market" and can be employed directly by different departments of the smart community which will contribute to building all kinds of application systems. The sharing platform contains four subsystems: data management system, public service system, sharing and exchange system, and operation and maintenance system. *Figure 5* has demonstrated the architecture of the information sharing platform. Each subsystem of the information sharing platform has their own function in the whole architecture (*Figure 5*):

(1) Data management system. This is responsible for producing, updating, maintaining and daily managing the data of the sharing platform of the Smart Yishanwan community. Data maintenance personnel are the main users of this system.

(2) Public service system. On the basis of the unified spatial platform, this can realize query, statistics, analysis and applications, taking advantage

of a location based service. At the same time, the users from professional departments can publish and upload thematic information of their departments, provide all sorts of data services and secondary development interfaces and develop business application systems based on the data resources.

(3) Sharing and exchange system. This demonstrates the data resources the platform contains and data service and function service it provides, so that users can rapidly search the data resources included and figure out how to use those resources. The staff from certain departments can edit, update and maintain the thematic data online, which the departments take charge of. Data management personnel of each department are the main users of the sharing and exchange system.

(4) Operation and maintenance system. This system is an important component to guarantee the regular and safe operation of the platform. It is responsible for the operation, management and maintenance of the whole platform, including the monitoring of service, resource allocation of the system and physical condition of the platform. The managers of the platform are the main users of this system.
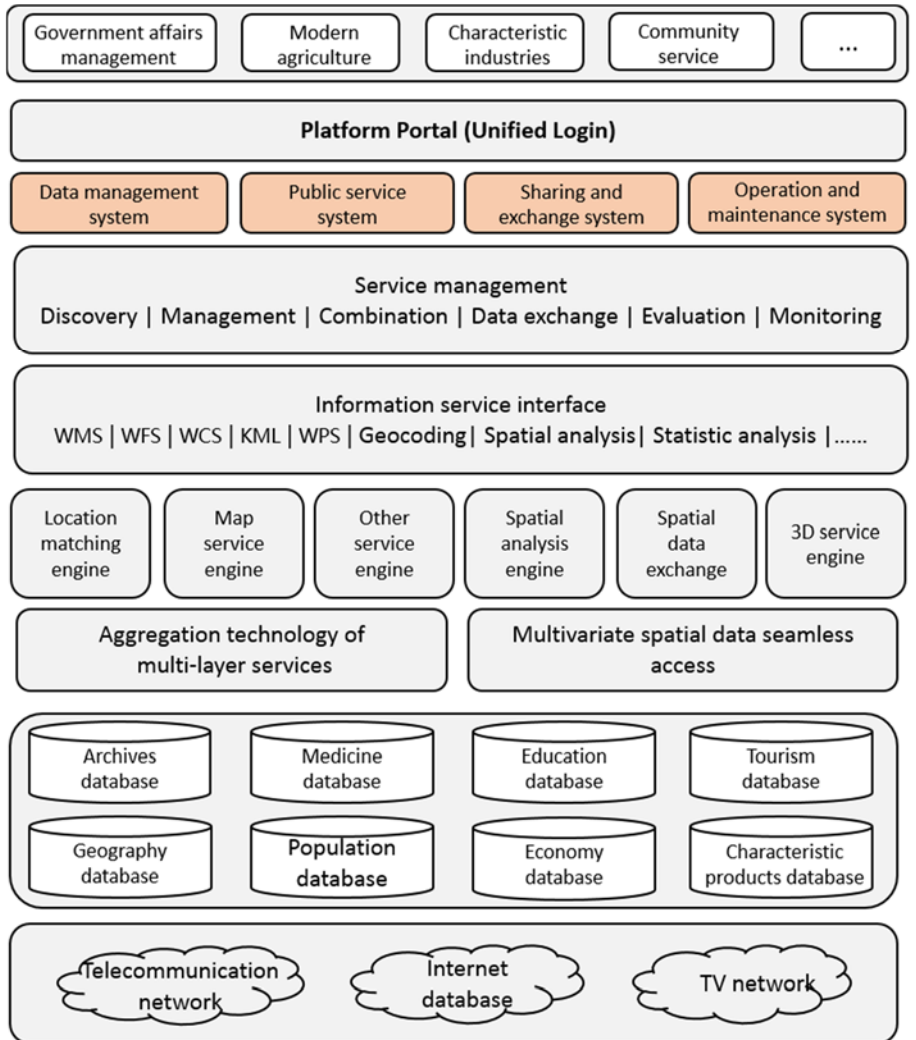

Figure 5. The architecture of information sharing platform of Smart Yishanwan community

3.2   Application of characteristic industries

The application of characteristic industries of Smart Yishanwan is mainly reflected in characteristic product marketing and smart tourism.

(1) Characteristic product marketing system

To develop smart industries is an important measure to promote the profound fusion of informatization and industrialization and is a significant approach to promote the optimization and upgrading of the Chinese industrial structure, more importantly, it is an indispensable part of the smart city (Feng and Jiang, 2011; Jin, 2012a). The development of Yishanwan smart industries focuses on the informatization of characteristic industries, facilitating the fusion of industrialization and informatization based on its own characteristics. It encourages enterprises to carry out networked, digital and intelligent upgrades on product innovation, product deep processing and product marketing, so as to enhance the impact of informatization on guiding and supporting the traditional industries. Compared to the traditional industries, the smart industries put more emphasis on the intellectualization, including the intellectualization of research and design, the intellectualization of manufacture, the intellectualization of operation and management and the intellectualization of marketing (Jin, 2012b).

In order to illustrate the development of the smart industries of the Smart Yishanwan community, we take a characteristic product marketing system as an example. The Yishanwan community produces lots of characteristic products, like rice, lotus root starch, lotus, etc. To expand their sales market, we must transform the traditional marketing channels and turn to the new e-commerce mode to improve the communication efficiency of information. The characteristic product marketing system takes charge of collecting, organizing, classifying, and analyzing the information of all sorts of characteristic products and expands their distribution channels relying on a well-run e-commerce platform such as TaoBao and Alibaba. The system needs to provide a platform for the enterprises, organizations and individual users to display products, to trade and to publish product information. Therefore, the system should have the function of commodity categories and display, commodities management, order management and website information release management (*Figure 6*), aiming to promote the circulation and transaction of the characteristic products and provide impetus for community economic development.
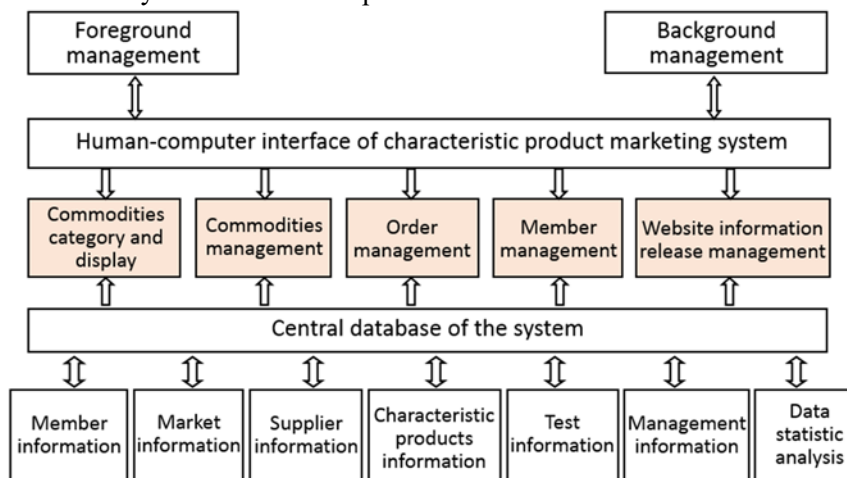

Figure 6. The structure of the characteristic product marketing system of Smart Yishanwan

(1.1) Commodity categories and display. These realize the category management and hierarchical display of the commodities so that the browsers can reach their target goods quickly and conveniently.

(1.2) Commodities management. This improves the accessibility by modifying the classification of commodities along with the change of the characteristic products.

(1.3) Order management. This adds the features of new order production, order disposing records, order inquiry and order statistics etc., to improve the user experience.

(1.4) Member management. Users can apply to be registered members of the platform and by storing the information and shopping records of the members we can establish a valuable customer database.

(1.5) Website information release management. This publishes the information of the characteristic products, enterprises, supply and demand, business negotiations and price etc., to improve the transparency of information and resource utilization rate, simultaneously promoting the products transaction and industrial development.

(2) Smart tourism information system

Smart tourism is one significant subsystem of a smart city where we can take advantage of the existing achievements of a smart city to realize some functions of smart tourism. Smart tourism on the one hand aims at satisfying the personal demand of tourists; on the other it achieves the goal of combining public service and public management of tourism efficiently (Zhang, Li, et al., 2012). The Smart Yishanwan community focuses on the leisure tourism; by developing smart tourism it will accelerate the development of characteristic industries, as well as be an effective way to improve the comprehensive competitiveness of Yishanwan characteristic industries.

The Yishanwan smart tourism service system unites local unique tourism resources and makes the best of cloud computing and the internet of things by means of laying internet, WLAN, smart terminal facilities and adopting electronic ticket systems and intelligent navigation systems. A smart scenery spot will be constructed so as to improve the attraction of Yishanwan tourism resources and accelerate the development of the tourism industry. A Yishanwan smart tourism information system mainly contains tourist services and tourism management. (*Figure 7*)
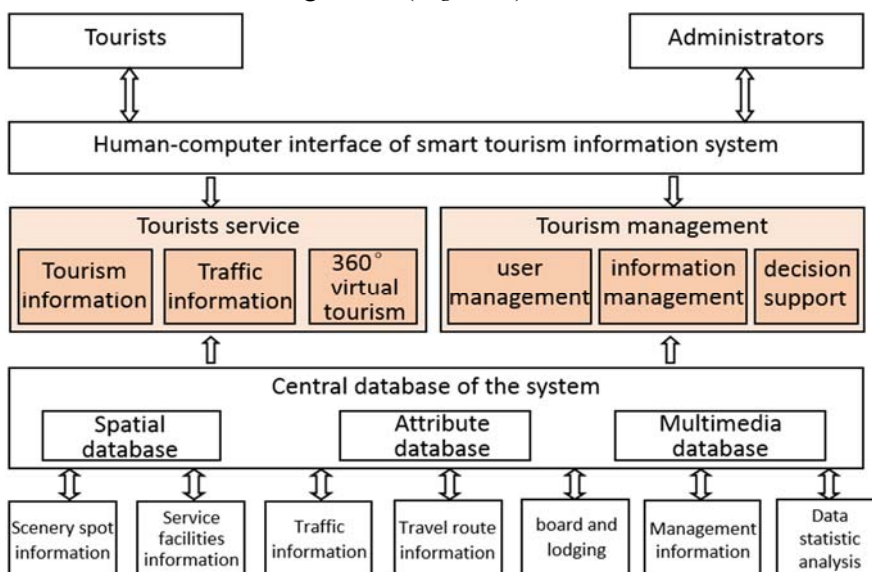

Figure 7. The structure of the smart tourism information system of Smart Yishanwan

(2.1) Tourists service. The functions which serve the tourists contain tourism information, traffic information and 360 degree virtual tourism. Tourism information service: displaying an overall view of Yishanwan's abundant natural and cultural landscape, providing detailed information of scenic spots and accommodation, as well as food, shopping and medical treatment which are accessible through several kinds of inquiry modes. Traffic information service: taking full advantage of the resource of Jiangxia District and Wuhan traffic information, offering information queries about flight, train, coach and bus, displaying the condition of traffic routes dynamically. 360 degree virtual tourism service: tourists can stroll the zone virtually under the system through some simple operations like full width display, zooming in, zooming out, roaming and Hawkeye navigation. Through these functions, it will help the tourists experience 360 degree virtual tourism so that they can quickly find zones of interest or specific targets.

(2.2) Tourism management. The functions which serve the tourism administrators contain user management, information management and decision support. User management: the administrators can supervise the whole system after logging in and they can supervise the user permission, travel information, travel route and user messages. Information management: it realizes the functions of travel information addition, new scenic spot approval, information modification and removal, and sets the limits of accessibility authority to professionals or the public based on the specific contents. Decision support: this builds the tourism resource evaluation model, zone capacity model and development evaluation model, in order to provide support for reasonable analysis and long-term planning.

CONCLUSION

This research on smart community planning of Yishanwan towards new urbanization aims at the synchronous development of informatization, new industrialization, agricultural modernization and new urbanization. We are trying to make great use of advanced technologies such as the internet of things and cloud computing, in order to achieve human-oriented development and accelerate research progress toward leading technologies with the drive of service-oriented and ubiquitous networks. At the same time, we are making efforts to transform the advanced achievements of informatization into the fields of production, life and management, so as to provide more convenient and flexible applications and service modes for community public management and to offer more efficient and intelligent methods of production and operation for economic development. The development of the Smart Yishanwan community will propel the construction of the infrastructure of the internet of things and positively facilitate the fulfillment of some particular programs including archives management, quality supervision of agricultural products, tourism service and smart community service etc., in order to effectively promote the innovation of community operating mechanisms and management modes, making the Yishanwan community a national paradigm of new urbanization. We hope this framework and method of creating a smart Yishanwan community can be a valuable reference for other communities.

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Regeneration of Historic Area with Social Orientation：

Investigation and Analysis of Three Historic Areas in Beijing

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Abstract: Under the research framework of changes in morphology, as well as social structure in historic areas in Beijing, this study carries out investigation and quantitative analysis on living space and social and economic problems in Shichahai, Xisibei and Nanluoguxiang, and conducts a sample analysis on typical courtyards. Scholars from different fields analyzed issues of social space reconstruction and cultural value protection from the perspectives of political and economic factors and cultural heritage protection and explores strategies for traditional courtyard improvement from the perspectives of physical space and public policy, though the tracking investigation and empirical analysis on the regeneration of traditional courtyards regarding social orientation is quite limited. In this paper the author analyzes social problems existing in physical and social space changes and explored sustainable regeneration strategies for traditional courtyards with social orientation, in Beijing, employing literature research, sampling investigation, participatory observation, in-depth interview and reconnaissance mapping methods.

1.   INTRODUTION

In the late period of the 1970s, large-scale transformation and renewal in western countries gradually reduced, a stage of regeneration came, and the "Amsterdam declaration" (European Parliament,1975) on the basis of reflection on modern urban renewal ideas, put forward the concept of integrated protection, comprehensive exposition of the social significance of the protection of cultural heritage and positive roles. The "Machu Picchu charter" (1977) further emphasized that a city's personality and characteristics are determined in urban structure and social characteristics. "The Xi'an declaration" (ICOMOS, 2005) represented a new consensus on the protection of cultural heritage in the new century; the protection of cultural heritage within the surrounding environment and the environment itself contains all the historical, social, spiritual, economic and cultural activities.

Many scholars and institutions play an important role in the protection of historic areas and social issues. Concepts of social fairness and justice were put forward (Harvey,2010) and people-orientation was focused upon ("Everyone's history area"(2008)). The concept of focusing on the interaction between humans and space was widely accepted in city

geography, sociology, city ecology and other fields (Lefedrve,1979;Dear and Wolch,1989; Knox,1994), and was applied in the protection of historic areas.

In the study of historic areas, research of social, cultural and environmental values of the historic areas has received attention. Heath (1996), in the "Revitalizing Historic Urban Quarters", summarized the value of an historic area. Alan Middleton (1987), in "Regenerating the inner city: Glasgow's experience", researched the problem of community participation in the management of historic areas. Kolb (1990) treated each reconstruction as an example of healing or making whole, the city, referring to it as "incremental rereading".

In the protection of historic areas in Beijing, a preliminary exploration on "organic renewal " was started in Shichahai area in 1979, Wu Liangyong proposed to maintain the original community structure and pay attention to social function and cultural connotations of residential courtyards in 1991 in order to explore suitable ways for updating residential areas in old Beijing city, which became an important direction in the protection of historic areas in old Beijing city (Tan,1997; Fang ,1998).

With the maturity of concepts of historical and cultural protection (Bian,2010), some scholars began to study housing problems during the renewal of old Beijing city from the perspective of social impacts (He ,1991; Zhang,1999; Jiao ,2004) and emphasize the updating and evolution of social structures in order to avoid dramatic change and realize gradual development and interaction (Bian, Jing,2005). They also gradually realized a consensus to some degree. Small-scale, incremental and organic updating of the city was implemented (Shao, 2005) and they also started to carry out social assessments on practices in historic area regeneration(Lv,Wang ,2013).

Historic areas of Beijing were delineated over 10 years ago. Although certain achievements have been made in terms of cultural heritage protection, street function and facility improvement and other aspects, many issues still exist. Recently, in systematic research work on sustainable recovery of historic areas in Beijing (Bian,2010), a number of scholars have paid attention to protection values (Feng,2011)and sustainable regeneration of historic areas (Lv ,2014).

This paper carries out a comprehensive survey of the different types of samples, analyzes social issues existing in housing improvement, discusses social space reconstruction mechanisms in the revival of historic areas and proposes viable strategies for housing improvement in historic areas.

2.   TECHNOLOGICAL FRAMEWORK, RESEARCH METHODOLOGY AND DATA DESCRIPTION

2.1   Technological framework

A literature survey, questionnaire sampling, interview, participant observation and reconnaissance mapping methods are adopted to obtain various types of data for old Beijing city. Three historic areas and some typical courtyards with problems existing in heritage protection and housing improvement are selected for review and the author analyzes features of social structure, housing demands and social space, as well as their interaction, and proposes viable strategies and methods for traditional residential courtyard regeneration.
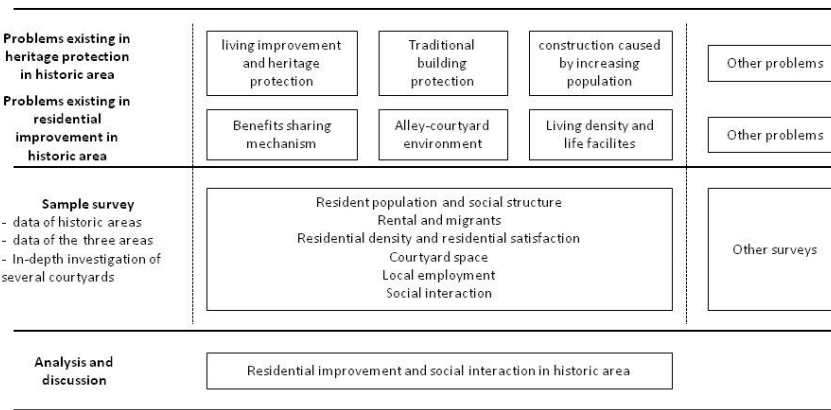
Figure 1. Technological framework

2.2   Research methodology

Case interview method: in the process of exploring the research direction, case study interviews were taken as a method, providing a directional reference for the questionnaire survey and quantitative analysis.

Sampling survey method: taken according to the actual situation using a fixed distance, random sampling method, and results of the survey are checked.

Quantitative analysis method: using factor analysis, correlation analysis, regression analysis and other methods, establishing a model of measurement of neighborhood relationships and public participation, explaining the social problems in the regeneration of historic areas by the method of quantitative analysis.

Cross research method: In this paper, the research on the protection of the material space and the social space theory are both carried out. On the basis of cross research, this paper hopes to form a comprehensive research method.

2.3   Data Description

2.3.1 Data from protection plan implementation assessment in historic areas of Beijing

In 2013, Tsinghua University and five other organizations were entrusted by Beijing Municipal Commission of Urban Planning with carrying out plan implementation assessments on Shichahai and 13 other historic areas to assess protection measures and results in heritage and cultural heritage, social structures and residents' lives, land and building, municipal infrastructure, function and industrial development, plan implementation and management, public participation and other aspects. In this paper, the assessment data is used as background data.

2.3.2 Investigation of Shichahai area

Shichahai historic area is the largest historic area in Beijing, since the 1970s, Tsinghua University has carried out follow-up studies and continuous work in the area for over 40 years. Between 2000 and 2013, great changes took place in the protection of cultural relics, space environment improvement, municipal infrastructure building, alley and courtyard renovation and cultural tourism development, but there were still some problems in social continuity, living condition improvement, travel and commercial development.

Between 2009 and 2014, the author participated in follow-up investigations on population, housing and commercial development in the Shichahai area. A questionnaire survey on 500 households in the Shichahai area in 2013, a reconnaissance survey on 1963 shops in 2010, a residents interview survey on 20 courtyards in 2012, an overall relocation follow-up survey on six courtyards in 2014 and a Shichahai housing and environmental improvement project to obtain housing survey data in 2014 were all conducted. In this paper, the author uses the data for the area to analyze relationships between business development and housing improvement, moving populations, local employment and social interaction in the rapid commercial development of the historic area.

2.3.3 Investigation of Nanluoguxiang area

Since 2000, the Nanluoguxiang area has witnessed rapid development of tourism and business and made great achievements in alley environmental remediation, "microcirculation" courtyard renovation, Yuhe protection and renovation work, but at the same time, excessive commercialization and branding, poor housing quality and a serious shortage of living space are obvious issues in the area.

Between 2008 and 2010, the author participated in follow-up surveys on business conditions in the Nanluoguxiang area to obtain comparison data on tourism and business development in the area. In 2014, the author participated in in-depth investigation on the No. 29 courtyard in Yuer alley, including a literature survey on the evolution of the courtyard, a courtyard housing quality survey, an interview with residents housing interior mapping and other content. In 2015, the author participated in questionnaire surveys and received 753 questionnaires regarding combined population, housing and commercial development data of the area in order to study microscopic mechanisms of interaction between the government, market and residents in the development progress of historic areas.

2.3.4 Investigation of Xisibei area

In 2009, the author participated in housing quality and style surveys on 2319 courtyards and 14,638 houses in the Xisibei area and a rigorous sampling survey on 1000 households in the area, as well as an investigation on population, employment, housing and infrastructure, residential satisfaction, repair participation and development expectations in the area. At the same time, a comprehensive reconnaissance and a rigorous sampling survey were conducted on 605 shops, a questionnaire survey was carried out on 120 shops and the author also carried out an analysis on features of practitioner groups and service groups. In this paper, data from the area is

used to analyze factors related to residential satisfaction and the relationship between living and commercial development.

2.3.5 Data Description

Data from protection plan implementation assessments in historic areas in Beijing are used as the basic data, including the overall population, age structure, family structure, housing situation, the status quo, the status quo of the municipal infrastructure, commercial development and other objective economic and social and material spatial data, but does not include the subjective will, family income, occupation and education level and other data.

Questionnaire surveys in the Shichahai area, Nanluoguxiang area and Xisibei area mainly include four parts: economic and social data, housing data, evaluation and demand data and public participation willingness data. Total effective samples were 500, 763 and 1000 respectively.

The questionnaire used in this paper mainly includes:

1）Age, household registration, family members, education level, occupation, monthly income and annual income, residence time and the resident population;

2）Working place, transport mode and the status of use of various public facilities；

3）Housing property rights category, quantity, quality, structure, area and use;

4）The type and use of housing water supply, drainage, heating, fuel, bath and toilet;

5）Neighborhood cognitive range, neighborhood relationship evaluation, daily communication network, holiday communication network and regional development evaluation;

6）Degree of housing satisfaction, relocation intention, the influence of relocation, participation willingness, degree of public participation and tendency to repair.

3.   ANALYSIS

Beijing has undergone several major social transformations; physical and social space interactions have witnessed profound changes (Bian,2010). Periodic change took place after the founding of new China (Feng,2011), so in the current situation, the social space concerns how living within and the regeneration of historic neighborhoods are affected. Should the reconstruction of the social space be guided so as to realize the regeneration of the historic area?

In a historic area, how to improve the living situation is a long-term issue, but has not been properly addressed in order to promote the development of commerce, tourism and the easing of population pressures. Measures have not solved heritage conservation problems nor improved their contradictions with modern living. Therefore, a method should be found for coordinating heritage conservation with high density living. In addition, how to ease the ongoing situation regarding how commercial development and population factors can be coordinated in order to promote the improvement of living should be considered.

3.1   Social and living problems in an historic area

3.1.1   The increasing polarization of social structure

The author analyzes changes in the social stratification standards of the old Beijing city (Shi,2011). In historic areas, income, occupation and education level of most resident populations is lower than those in other areas of the city. Meanwhile, among low-income groups, due to differences in domicile, residence time and age, there are obvious differences in social status, social interaction and lifestyle.

Due to the fact low-income population groups cannot increase income with their own skills, their financial capacity is insufficient to support their emigration; on the other hand, due to the high cost of land, those residents who can buy a house and live in an historic area are of a high-income group, which leads to a polarized development of social structure.

In short, in the historic area, due to ongoing population migration and population replacement processes, high education, high income population level of liquidity and the improvement of the middle and lower class groups are not obvious.

Table 1: The education level contrast between initiative immigrants and others in Nanluoguxiang area（Data sources Nanluoguxiang area surveys in 2015 ）

	College degree and above	Senior high school	Junior high school	Primary school	Illiteracy
The sixth national census data of Beijing	32.9%	22.1%	32.8%	10.4%	1.8%
Nanluoguxiang area	39.5%	30.1%	23.6%	5.2%	1.3%
Permanent population of Nanluoguxiang area	37.7%	31.5%	24.3%	5.3%	1.3%
Initiative emigration of Nanluoguxiang area	57.4%	19.7%	18.0%	3.3%	1.6%

Due to commercial development and low housing rent, a large number of migrants arrive in historic areas, but their appearance does not change the social structure of an historic area. On the one hand, migrant populations have little communication with local residents, they generally only interact in shopping, renting and other commercial activities, and there is no real neighborhood relation; on the other hand, health, noise, traffic and security problems caused by migrants have negative impacts on local residents, thus leading to social conflict between migrants and locals.

Generally, migrants do not have Beijing census registration, they are usually aged 20-40 and generally work nearby, their family income is not lower than that of local residents, but due to high rental, medical and education expenses and a lack of social benefits and access to cultural facilities and instable income, their actual quality of life is much lower than that of locals (according to results from a questionnaire survey in the Shichahai area). In addition, due to short living time and large mobility, it is difficult for tenants and residents to build trust. Tenants are generally disadvantaged in terms of daily social activities, contact with friends and family, motional communication and participation rights. The increasing number of migrants essentially means more residents of middle and low income level, this phenomenon continues to worsen and it is difficult to solve.

Table 2: The overall situation of the floating population in historic areas (Data sources: The implementation evaluation to the conservation planning of the historical areas in 2014）

Historic area	Type	Immigrants proportion	Family structure characteristic	Social economy characteristic
XiSiBei area	Mostly for living	20-25%	20-40 years old；"2+1+1"family；Non-native; Rental housing；	Low- and middle- income families；No social welfare；High proportion of rent, Education and medical expenses
Shichahai area	Commercial and residential mix	30%		
Nanluoguxiang area	Commercial and residential mix	30%		
Other historic areas	Mixed type	more than 20%		

Table 3: Economic and social situation of migrants (No. 29 in Yuer alley as an example)

Monthly income/RMB	0	Less than 3000	3000-4000	4000-5000	5000-6000	More than 6000
Number of people	1	2	6	3	2	3
Age	20-30	30-40	40-50	50-60	60-70	Over 70
Number of people	2	9	2	0	2	2

3.1.2 The housing problems of heritage conversation and regeneration of historic areas

High density residential situations in historic areas have a serious impact on heritage conversation and regeneration of historic areas and the living conditions of the residents are very poor. According to a survey on housing area, per capita property housing area is about 7-8 square meters, added building area is more than 20% of the property housing area and in some areas up to 50%, far below the reasonable level. Housing additions are mainly for kitchen and bedroom spaces which are used for meeting the basic

needs of residents. Without other methods to solve the basic living needs of the kitchen, bathroom and other conditions, these added buildings are irreplaceable in function.

Population pressures causing housing problems are difficult to solve quickly. According to the "Conversation Planning of 25 Historic Areas in Beijing Old City ", 118,000 people need to move out of the historic areas, about 41% of the total population of the historic area; according to the "Beijing city master plan (2004-2020)", by 2020, Beijing old city should have 33% of its people moved out, accounting for 550,000 of the total population of the old city; and according to the standard of 15 square meters per capita for residential construction areas, the total population of the historic area is required to be reduced by 35-40%.

The size of the population easeis difficult to achieve and would have a huge impact on the social structure of the historic area. Therefore, although the population ease in the protection of the historic area should continue to be promoted, it is not the only way to solve the problem and must be combined with other ways to promote the improvement of living in a variety of ways, including the use of underground space to improve the per capita housing area, housing renovation and upgrading of facility conditions, environmental improvement and so on.

Table 4: Housing area condition in historic areas (Data sources: field investigation in 2009、2013、2015）

Historic area	Per capital property area（㎡）	Per capita addition area（㎡）	Actual used area（㎡）	Useful information (Family number)
XiSiBei area	8.26	2.68	10.94	691
Shichahai area	7.60	1.84	9.44	495
Nanluoguxiang area	7.76	5.11	12.87	288

3.2   Value of social integration

3.2.1 Social interaction in commercial and residential spaces

When businesses mainly serve tourists, the practitioners are mostly migrants who have very weak links with residents and when businesses mainly serve local residents, local residents offer convenience stores, restaurants, etc., while migrants with specialized skills provide repair and hairdressing services. (Shi,2011) Some shops which are not related to traditional culture appear in the public spaces of historic areas, at the same time, low-income people move into historic areas, which leads to an increasing shortage of living space. Business and tourism development cause negative impacts on local residents.

This analysis show that commercial development of historic areas has not brought about social interaction between residents, merchants and tourists, employment of residents has little association with tourism and business development and benefit sharing mechanisms are lacking. Service-oriented business development shows inward development where residents serve as the primary practitioners, and the rapid development of tourism and business does not bring benefits to local employment and the life of locals, while business development leads to a worsened surrounding environment, which causes increasingly serious conflict between locals and migrants.

Table 5: Employment situation in the business development of historic areas (Data sources: field interview investigation in 2009、2013、2015）

Historic area	Business type	Number of merchants	Employment of residents
Shichahai area	Retail and catering	41	2
Shichahai area	Tricycle service	36	0
XiSiBei area	Basic life services	148	80
XiSiBei area	Retail and catering	96	16
Nanluoguxiang area	All commercial type	152	12

Table 6: Evaluation of adverse impact on residents due to business development in historic areas (Data sources: questionnaire in 2009、2015）

The causes of residents' complaints about business development	XiSiBei area	Nanluoguxiang area
disturbing life atmosphere	12%	14%
traffic jams	21%	30%
safety factors	22%	22%
impact on rest due to late operation	21%	12%
sanitation decline	19%	21%
others	5%	1%

3.2.2 Social integration and public participation

Because of the reasons of housing placement, housing sale and the separation of registered and actual residences, the residential community in the historic area continuously changes and has an effect on the social relations between the residents. Investigation shows that the families living in the areas for a long time have a relatively stable social interaction network and have a close relationship with the neighborhood, but the social interaction with the migrant population is very rare, rejecting the migrant population. At the same time, the survey shows that the social contact with the migrant population is also very rare.

The data analysis reveals that neighborhood relations have an impact on public participation willingness. In the survey of Nanluoguxiang area, the measurement model of neighborhood relationships use neighbors' cognitive range, family communication numbers in a courtyard and family communication numbers in lanes as variables and is supported by using a factor analysis. Four variables can be explained by a common factor. (characteristic root=2.443, variance devoting rates=61.1%) Except for the factor load of "neighborhood", whose variable factor is 0.698, slightly less than 0.7, the other three indicators of have a factor load of more than 0.7, which means that the four variables reflect the potential concept of neighborhood relations well.

Table 7: The measurement model of neighborhood relations: factor analysis results (Data specification: adopting the questionnaire data from the Nanluoguxiang area, 2015)

Explicit variable	Exploratory factor analysis	
	Loading	Uniqueness
Neighbors' cognitive range	0.698	0.488
Family communication numbers in courtyard	0.765	0.586
family communication numbers in lane	0.807	0.650
family communication numbers in nearby lane	0.848	0.719

Analyzing related factors of public participation willingness will find that neighborhood relations, social capital and architectural style are direct factors impacting participation willingness, while family income, occupation period and construction quality are indirect factors. Some residents who live in a place longer have a higher family income and better housing conditions and will have more contact with the surrounding residents, a higher social status, stronger initiative and greater capacity to participate in repairing their house, so their wishes of maintaining the region are also stronger.

Table 8: Correlation analysis of public participation willingness related factors (Data specification: adopting the questionnaire data of the Nanluoguxiang area, 2015)

		Public participation	Neighborhood relations	Social capital	Family income	Construction quality	Construction style	Occupation period
Public participation	Pearson correlation	1	-.131*	-.166**	-.061	.102	.216**	-.050
	Significant (bilateral)		.036	.006	.317	.096	.003	.431
	N	271	259	267	271	269	185	251
Neighborhood relations	Pearson correlation	-.131*	1	.294**	.132*	.008	-.142	-.152*
	Significant (bilateral)	.036		.000	.030	.893	.050	.017
	N	259	271	267	271	269	192	249
Social capital	Pearson correlation	-.166**	.294**	1	.051	-.015	-.114	-.022
	Significant (bilateral)	.006	.000		.389	.804	.118	.728
	N	267	267	284	284	280	191	260
Family income	Pearson correlation	-.061	.132*	.051	1	-.101	.314**	-.034
	Significant (bilateral)	.317	.030	.389		.090	.000	.577
	N	271	271	284	288	284	195	264
Construction quality	Pearson correlation	.102	.008	-.015	-.101	1	.159*	-.136*
	Significant (bilateral)	.096	.893	.804	.090		.027	.028
	N	269	269	280	284	284	195	264
Construction style	Pearson correlation	.216**	-.142	-.114	.314**	.159*	1	.062
	Significant (bilateral)	.003	.050	.118	.000	.027		.412
	N	185	192	191	195	195	195	178
Occupation period	Pearson correlation	-.050	-.152*	-.022	-.034	-.136*	.062	1
	Significant (bilateral)	.431	.017	.728	.577	.028	.412	

*. At 0.05 level (bilateral) correlated significantly.
**. At.01 level (bilateral) correlated significantly.

Using neighborhood relations, social capital and construction style as independent variables and public participation as the dependent variable to carry out linear regression analysis. Because significance level of "social capital" variable is more than 0.05, eliminating the variable and remodeling can produce a linear regression equation. This indicates that the degree of

neighborhood relations and construction style have a very considerable influence on the willingness that the public toward participating in the historic area preservation and renewal.

Table 9: Regression equation coefficient table coefficient a (Data specification: adopingt the questionnaire data of the Nanluoguxiang area, 2015)

Model	Unstandardized coefficients		Standardized coefficients			B, 95.0% confidence interval	
	B	Standard error	Trial	t	Sig.	Lower limit	Upper limit
1 (Constant)	2.668	.276		9.663	.000	2.123	3.213
Neighborhood relations	-.244	.090	-.195	-2.702	.008	-.422	-.066
Construction style	.280	.099	.203	2.819	.005	.084	.476

3.3   Housing improvement strategy

3.3.1 Survey on the degree of satisfaction and residential improvement

According to an analysis of a population questionnaire survey in the Xisibei area in 2009, factors affecting living satisfaction are various and include housing area, housing ownership, quality of housing, living facilities, duration of residence, resident age, income, etc.

In a survey of the Shichahai area, it is found that residents are mainly dissatisfied with the living area (69%), housing quality (45%), living facilities (49%), parking (73%), toilet (70%) and bathroom (43%), which are especially obvious issues. According to a survey on migrants in the Shichahai area in 2013, the mains factors affecting their rental are being close to their workplace (37%), good public facilities (27%) and cheap rental (24%), which indicates that the housing needs of a large number of migrants are mainly driven by economic factors, rather than cultural or social factors. In the survey, it is found that due to concern about increasing rental, they often do not care about improving living conditions.

Table 10: Attribute analysis of satisfied residents in Xishibei area.

Factors affecting satisfaction	Proportion of satisfied residents	Proportion of entire area
Private households	35%	16%
Over 50 years old	77%	56%
Living time (before 1960）	57%	40%
Above middle income	17%	8%
Family living area (more than 40 square meters)	44%	22%
Per capita living space (more than 15 square meters)	44%	25%
Relocation tendency	6%	15%
House self-repair tendency	52%	37%

According to a survey on housing area needs in the Xisibei area, when real per capita housing area reaches about 15 square meters (family real housing area of about 40 square meters), residential satisfaction greatly improves. Through living space mapping and interviews, as well as research on housing type, it is found that small but complete houses with a separate kitchen and toilet is more suitable to meet actual needs in historic areas. In short, after certain improvements in the residential area, improvement of life facilities is the key to residential improvement.

This problem can be explained from two perspectives:

1) Inadequate housing area is a long-standing problem and it is related to intergenerational population growth in historic areas where residents' expectation values on housing area is too low. If residents move to other areas, the expectation value will significantly increase to 90-110 square meters (Cheng ,2011).

2) In daily life, issues related to life facilities directly affect basic life issues, especially for kitchen and toilet. After retrofitting houses, residents generally have a kitchen, and with an increasing aging trend, public toilets are not sufficient to meet the daily basic needs of residents; independent toilets are particularly urgent for improving living conditions.

3.3.2 Strategies for living satisfaction fragmentation distribution

Factors affecting the living satisfaction include housing area, housing property, housing quality, living facilities, living life, residents' age, residents' income and other factors. These factors in the area, even within a courtyard, are showing obvious fragmentation distribution and overall satisfaction is low, but did not form a concentrated area of low satisfaction.

According to the above analysis, in order to restore the traditional courtyard style, meet the actual needs of the residents with dual requirements, become decentralized and flexible, even the construction of courtyards for the implementation of units, and actively use the underground space appropriate to increase the use of space, living facilities can be improved following a reasonable direction maintaining the traditional residential courtyard.

Figure 2: Spatial distribution features of income in the Xisibei area

Due to an unclear property rights system over a long time period, residents' spontaneous actions do not have clear policy guidance and encouragement. 76% of them argue that the government should be responsible for living condition improvement, only 19% of them agreed on a government-market-residents cooperation mode in the Shichahai area in 2013. At the same time, under the influence of surrounding courtyard and architectural quality conditions, it is impossible to take a comprehensive update or removal approach.

In summary, the author supports respect for the evaluation of the quality of the courtyard, based on the wishes of residents, classifying residential housing improvement.

Table 11: Ways of improvement for living courtyard with social orientation

	Complete relocation of residents	Partial relocation of residents	Full retention of residents
Ways of improvement	Update and reconstruction, the use of underground space to improve living facilities, restoration of traditional courtyard space, change of use function.	Resident participation, demolition of added building, the use of underground space to improve living facilities, gradual recovery of traditional courtyard space.	Resident participation, removal of partial added building, implementation of transformation with building as a unit, the use of underground space to improve living facilities, the improvement of yard space.
Ways of improvement	Relocation of some residents, demolition of added building, repairing house and improving living facilities, restoration of traditional courtyard space, change of use function.	Update and reconstruction, the use of underground space to improve living facilities, restoration of traditional courtyard space, relocation of residents who move back.	No transformation of architecture, improving living facilities, carrying out environmental remediation.

4. CONCLUSIONS AND DISCUSSION

Social integration promotes historic area regeneration through multiple forms of participation. Although there are many studies about public participation, most of them focus on the procedures, tools, ways,etc. Through data analysis, this article suggests that by the rehabilitation of neighborhood relations and the management of a floating population, social spaces could be guided away from separation toward integration and may stimulate motivation toward protecting the historic areas, which is the basis for regenerating residential streets.

The transformation of business formats would cause a change of working groups. From the points of promoting social reconstruction and remodeling the social structure, the management of the formats should increase employment and residents' participation, setting higher demands on employers' skills and cultural awareness. In that way, it would lead formats to develop in a more economic and socially beneficial direction.

The essence of the residents' housing appeal is similar, but due to the difference of socio-economic attributes, the tendencies to improve housing is complex and various. The differences of motivation and ability in active participation are even greater, so the improvement method should also be diverse, flexible and sustainable. Specific methods include population diversion, appropriate use of underground space, improvement of housing quality and basic infrastructure such as bath and kitchen, environment renovations of lane and yard, etc. Meanwhile, practical subjects should be diverse and the stage and degree of government leadership, market and residential participation should be structured with flexibility according to the specific conditions. If the implementation emphasis is on a single living improvement model, the regeneration of historic areas could not be achieved in a sustainable way.

In this respect, the discussion of social regeneration in Shichahai Daxiaoshibei lane is a valuable study direction, which adopts diversified improvement approaches to reconstruction and renewal, operating via a mode of policy-oriented and social investment. In general, through overall strategies of respecting residents' wishes of moving out or staying in a flexibly distributed way, an improvement to living conditions and courtyard regeneration can gradually be achieved.

Considering the endogenous mechanism in residential yards, public administration policy should enhance the management of lodgings to promote trust and interaction between residents and tenants. By the means of social interaction, it would stimulate the public to participate in beautification campaigns of courtyards. In addition, courtyard environments can gain continuous improvements by virtue of community cohesion and cultural blending.

There have been multivolume studies about integral conservation of the Beijing old city. Based on the research of scholars in various fields, this article starts from an angle of community integration and residential condition improvement, but it is not exhaustive. Moreover, it is difficult to extend deep discussion on many aspects within a single analysis, including cultural value analysis of traditional courtyards, partitioned ways for different types of courtyards, the standards and methods of housing improvement and possible paths of public participation. Toward the overall protection of Beijing old city, it is hoped that further studies attach importance to social continuation and that people's livelihoods could

continue. Consideration should also be given to reasonable change sequences in the social spatial structure to realize sustainable revitalization of historic areas while achieving material, spatial improvement and cultural renaissance.

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Integrated Neighbourhood Network on A Case Study of Condominium Community: Nimmanhaemin District, Chiang Mai Thailand

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Abstract: Chiang Mai is the second biggest city in Thailand. With its own history, this city has been represented as a culture city but many economic growths have been increasing at the same time. Many areas in the city are turning toward economic purposes, especially Nimmanhaemin District, which is currently well known as a business district for dining and entertainment spots where it was originally a planned area for single house real estate and had followed grid system planning following modern thought since 1980s. The strong character of this district is in its street network which is related to the grid system and provides for communities on "Soi" (Thai, meaning alleys that connect to the main street). With rapidly economic development in the last 15 years, area uses on the Nimmanhaemin street network have been turning toward business purposes and have grown without direction or limits. The most invested in are residential and commercial uses. There can be found numbers of new apartments which were built into old residential areas. In addition, researchers have found conflicts and controversies between old residents and new communities which are permanently related to urban management such as traffic circulation, zoning, image of the city and community design. Because previous government strategies were lacking local input, analysis of existing communities' relations is required. This research hypothesis is to posit sustainable communities which move forward with a "Community Drive" where cultural and creative activities create a balance between social relations (Existing residents and present business grouping) and business aims. Then, this research aims to integrate "Neighbourhood" into apartments which lack social interaction and public mind as a part of community. This research methodology identifies the relationship between existing residents and present business groups which refer to concerned theories; "The Production of Space" theory by Henri Lefebvre and "Neighbourhood" by Nicholas Patricios, which defines the "Neighbourhood" concept as a retrospective of physical design and social interaction. Analysis was conducted based on community participation and questionnaire data. The implications of this research are applications and strategies toward integrating a "Neighbourhood Network" on a condominium floor plan for a case study of a condominium community.

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1. BACKGROUND

1.1 City planning

Chiang Mai City was established as Lanna Kingdom and its city planning has existed since 1296. With "Taksa Muang" being the ideal system, city planning was managed by following this ideal. Chiang Mai Old City originally referred to a human body, with the head at the north of the city as a main entrance for the emperor; the foot in the south, intended to be a negative side, for example, for graves and lower-class people; the right hand side is on the east of the city which connects to Ping river and was for living and commercial areas; while the left hand side is the west of the city which connects to Suthep Mountain for religious and educational purposes. The centre of the city is set in the middle as a navel of the human body. In Figure 1, Chiang Mai's three street cycles or rings connect Chiang Mai to the expanding areas.
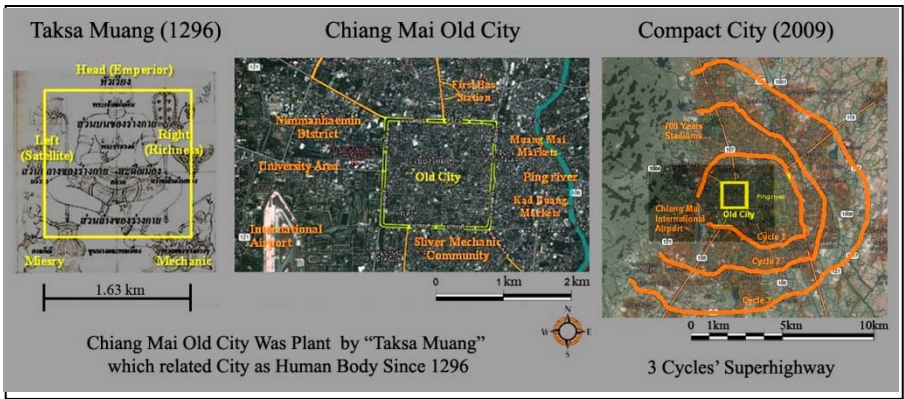
Figure 1. Chiang Mai city planning from Tuksa Muang (1296) to Compact City (2009)

Nimmanhaemin District was planned in the early 1980s. Nimmanhaemin District was owned by the Nimmanhaemin family. This land is a part of the first road cycle which connects with the superhighway, it is four lanes wide and 1.327km long. This street connects to other districts and also to the education node of the city. After this land was sold to individuals, Nimmanhaemin was originally planned for real estate and single house villages following modern thought. In Figure 2, those areas and streets can be seen as being physically bound by the grid system.
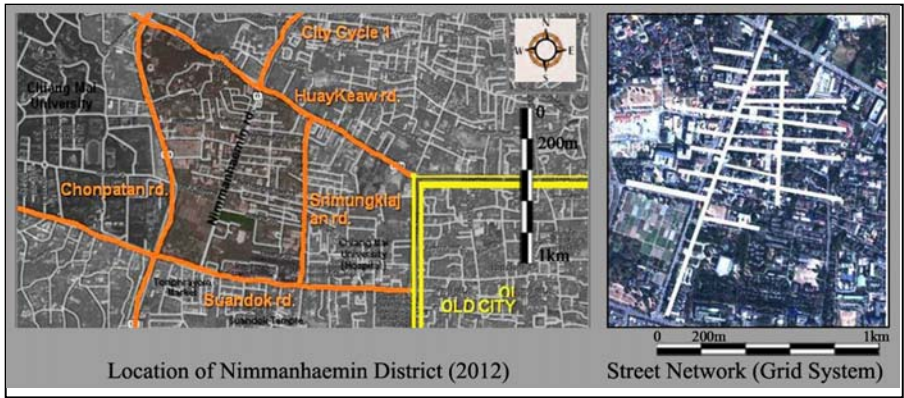

Figure 2. Nimmanhaemin Street Network (2012)

1.2   **Community grouping**

In Thailand, a community is originally grouped based on nearby areas residents around temples. A temple is reasonably the centre of the community where all residents are bounded with Buddhist activities and traditional events. Following modern development, the city was planned for infrastructure and public transportation which connects other districts with street networks. Until now, the temple is still maintained as the community centre for present activities such as elections, funeral ceremonies and Buddhist events. Nimmanhaemin District alone was planned as single house villages in the 1980s. Before that, there was an agriculture field owned by one family. In the northern part of Nimmanhaemin District, the Nimmanhaemin street network was created following a grid system that was stated by real estate investors. At first, this area was combined with residential villages which were established as early modern single houses, townhouses and shop-houses. As modern conceptual planning came about, those houses were grouped as an individual village by any private investor. Then, those communities were personally divided and no longer had permanent community centres (*Figure 3*).
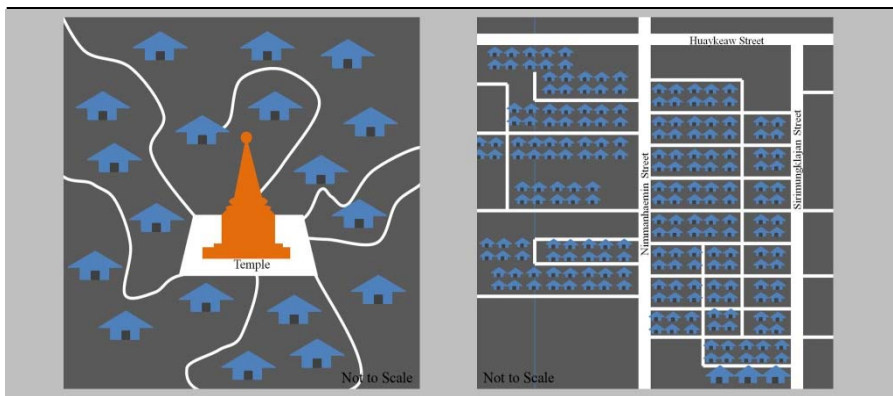
Figure 3. Comparing Community Grouping between Ordinary district in Chiang Mai
and Nimmanhaemin District

Most districts in the town are treated from a traditional perspective with districts being developed on old community ideals. For example, Wualai Community, an established silverware village, has Srisuphan Temple as its community centre. Nowadays, this community has changed and has a variety of commercial wares, but still maintains its silverware village for tourism and holds a weekly market. This strategy allows a community to be a creative city which creates a balance between social relations and business aims (Sirorod and Ongsavangchai (2012)). However, Nimmanhaemin District is a new district which was developed by investors. There is therefore no community centre or cultural background; there was just a residential area in the beginning.

1.3   **Problem: Zoning & Regulations**

Following economic development, investment rapidly increased for commercial and residential purposes. Those villages and real estate were opened for individual investment. With its geography as a grid system, this district became a business network. In the beginning, shops and studios around Nimmanhaemin grouped themselves and have held annual markets for showing their products since 1999. Since then, that area has become

known as an art and design district. Not too soon after, rapid economic development occurred in the following 20 years, many residential properties became commercial and Nimmanhaemin has now been well-known as an economic district since 2004. The government has pushed this area as a commercial area without taking care of old residents. The number of investors is increasing rapidly and is not controlled. The investment activities disturb old residents which has led to two main issues.
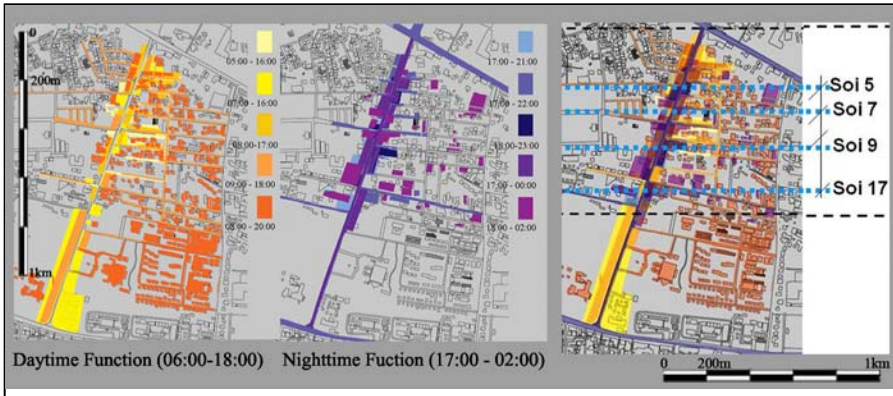

Figure4. Overlapped Daytime functions (orange zone) and Nighttime Functions (blue zone) on Nimmanhaemin sitemap (2012)

The first issue is zoning. According to present businesses which disturb the residential area, this research focuses on the relationship between timing and areas. To specify, area uses are highlighted as having either a day-time function (coloured by orange tones) or a night-time function (coloured by blue tone). Those colour tones represent periods of use on the site with lighter shades showing how early those uses are and darker shades show how late those uses are (*Figure 4*). After this surveying, overlapping colours on the sitemap determine areas where both day and night functions are, and where they potentially overrun and have already disturbed residents in the surrounding area. Those areas are on the main street and located on Soi 5, 7, 9 and 17 where cafes and night bars are mostly located.
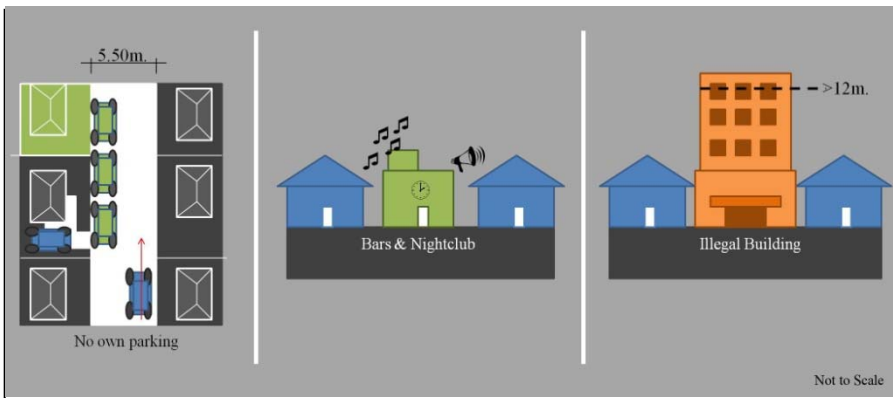

Figure5. Controversies on Regulations in Nimmanhaemin District

The second issue is that there are no regulations for controlling new investors. Nimmanhaemin District needs to create a balance between old communities and present investment. Many new investors renovate and build buildings freely. Without updating regulations, many shops have no parking of their own and their customers often park their cars blocking residential access. Many bars and nightclubs ruin residential areas with noise pollution. In addition, many apartments and condominiums are built not following regulations which restrict the height of buildings to 12 m. From

these conflicts, Nimmanhaemin needs to develop itself based on sustainable thought from its own community drive.

2.   LITURATURE REVIEW & METHODOLOGY

2.1   Defining of "Neighbourhood"

The "Neighbourhood" concept, refers to the research of Nicholas N. Patricios in 2002 which defines "Neighbourhood" as a retrospective of physical design and social interaction (Patricios (2002)). He claims that a major issue of "Neighbourhood" has arisen in the applications of both forms of the concept since the 1930s. This has been the assumption regarding the nature of the relationship between the way the physical environment is arranged and the linkage with social interactions between neighbourhood residents. Then, integrating "Neighbourhood" design into apartment planning, there is a focus on the following two issues.

First, physical design. Perry (1929) identified principles of the neighbourhood unit plan as a fixed size based on the service area of his research (an elementary school and communities nearby) with a one quarter mile walking distance, boundaries formed by arterial streets, scattered small parks and open spaces which formed ten percent of the total area, various institutional sites including a school at a central neighbourhood or community centre, local shops on the periphery of the neighbourhood, and an internal street system to discourage through traffic. These principles were all of physical perceptions. His summaries claimed that "physical design" is effective in terms of perceptions and also bounded people in the community towards being neighbours. In addition, he referred to perceptions of route and street scenes that potentially combined people and have represented friendliness and unity perceptively as "Neighbourhood" in terms of physical design.

Second, "social interaction". Patricios referred to Perry's research of approaching the physical-social continuum as opportunistic. To better understand his viewpoint it is necessary to briefly examine his personal experience (Perry (1921)), in particular, the progressive reforms activities in housing and social welfare that had begun in the late 19th century. The aim of the reformist movements was to improve social interaction so as to redress the urban environments that were seemingly hostile and anomic. Perry proposed his neighbourhood unit concept with a central community centre where people of the neighbourhood could gather. The centre has to bound people with social participation. Those propositions explained that "Neighbourhood" is to posit a community's centre and is a place for the gathering of people with their needs or advantages.

2.2   The production of space

This research analyses data from questionnaires to identify relationships between people's activities and areas. This method, when applied to studies on western modern cities and planning was edited by a French social scientist named Henri Lefebvre (Lefebreve (1992)).

Lefebvre posits that "place" is a sort of "located-ness". It is a geometrical space and accounts for the fact that two things cannot occupy the same place at the same time. In modern city planning, there is a managed grid system.

All the areas are controlled by government laws and rules. Governments give single meanings and function to each area. Lefebvre explained "place" as "the representation of space", but on the other hand, Lefebvre posits that "space" is another kind of area and remains as "practiced place." In addition, "spaces" are determined by historical subjects, by the users of places. Thus the street geometrically defined by urban planning is transformed into that area by walkers. Lefebvre explained that area as a "space" or "representational space" which is on the other hand directly lived through its associated images and symbols, and hence the space of inhabitants and users. "Space" is flexible to users' perceptions and historical and present geography. In the analysis section, this paper analyses areas which have potential characters as "space" to be able to restate an area and its design planning for integrating "neighbourhood" conceptual design into those areas.

2.3   Methodology

The methodology of this study posits the neighbourhood concept combined with two areas of study; 3.1 Social Interaction and 3.2 Physical Design. In the analysis, the authors collect data from workshops and questionnaires to analyse the production of space in this district. As a minimum, this research aims to integrate the neighbourhood concept with two outcomes; 4.1 Application for Physical Design and 4.2 Regulations for Supporting Social Interaction (*Figure 5*).
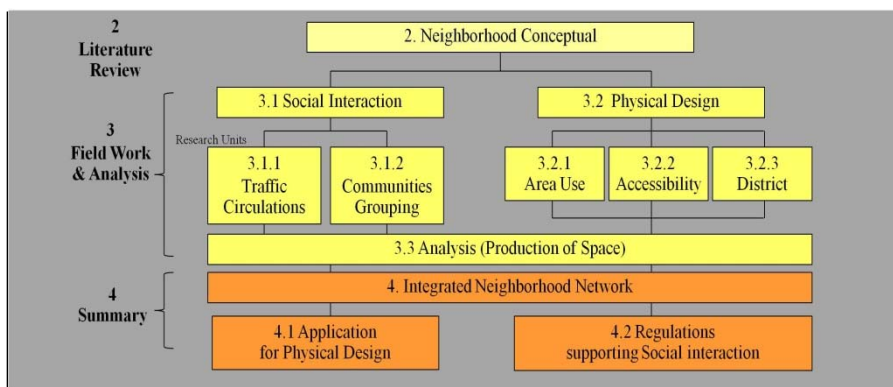

Figure 5. Methodology

3.   FIELDWORK & ANALYSIS

Since collecting resident data during 2008-2014, residential trends in Nimmanhaemin District are mostly explained by apartment and condominium investment activities. Caused by economic forces, land prices around Chiang Mai City, including Nimmanhaemin District, have increased rapidly. In 2008, those land prices that had cost around 20,000 baht/Sq.wah (1 Sq.wah = 4 Sq.m) had had their land prices grow to 50,000-70,000 baht/Sq.wah. within just five years (Akom (2012)). For this reason, investors have to adapt their business strategies to gain an increased profit. Condominium businesses have been massively invested in around the Muang District over the last 15 years. In particular, a condominium unit's price, where located in the city center, has increased dramatically from 30,000 baht/Sq.m. in 2012 to 50,000 – 60,000 baht/Sq.m. in 2014 (CRUCMU (2014)). Research lists the condominiums which were planned to be built and constructed during the period 2009-2014 around the Nimmanhaemin

area. (*Figure 6*). Regarding urban regeneration, apartments and condominiums are connected to modern lifestyles and there also lacks community participation. This then leads to problems and complexities with old residences (single houses and row-houses).
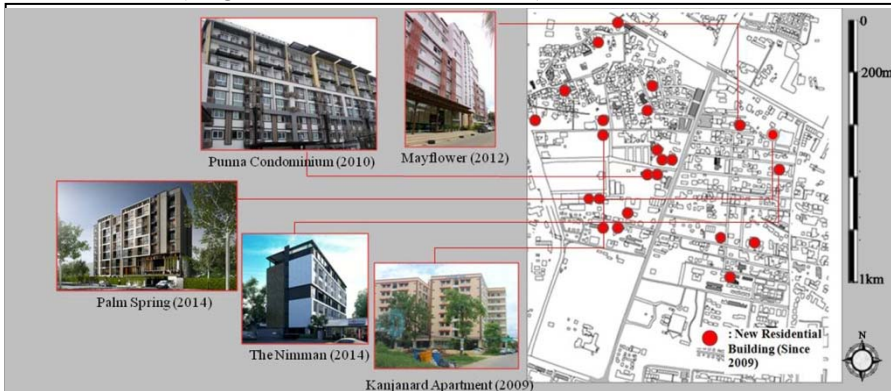

Figure 6. New Residents on Nimmanhaemin Sitemap Since 2009

3.1   Field work: social interaction

During March 2014, questionnaires were conducted to collect community data with 166 participants, which consisted of 62 residents and 104 workers around the district. According to the questionnaire, community relation and traffic circulation maps were created.
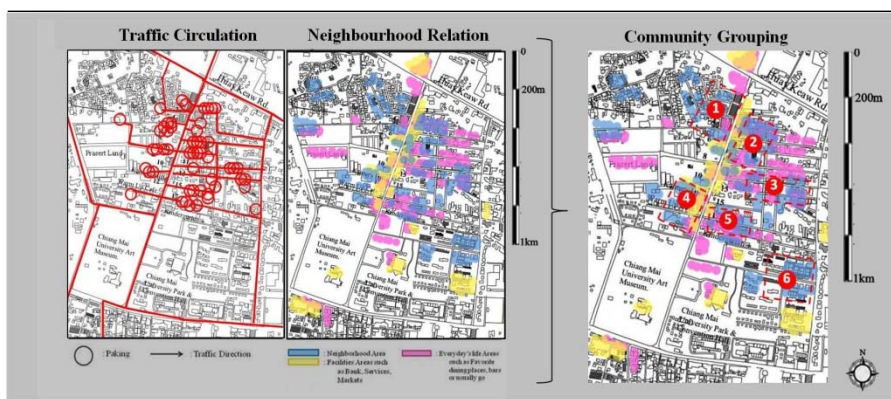
Figure 7. New Community grouping from traffic circulations and neighborhood relations

3.1.1   Traffic circulation

From questionnaires, the worst problem was "Traffic Jam" which could be managed via a government strategy. Regarding traffic circulation, questionnaire results have shown that the densest traffic in this district is on the east side where old residential and new investment buildings are located. In particular, there is a 5.5 m. wide street which does not accommodate two-way traffic or parking on the side of the street. Moreover, questionnaire results found that primary solutions from residents are "Doing nothing" and "Talking with Neighbours". Those are individual tactics and solutions showing no sign of how government and community can solve this problem long-term.

3.1.2   Community grouping

This study collected zoning and area use data with local participation. Divided areas were painted on a sitemap where they usually relate to

Neighbours (blue), Facilities (yellow) and Everyday uses (pink) *(Figure 7)*. These questionnaire results show areas which relate to each other as six new grouping communities. They include: Community 1, "Promenada". This community covers Nimmanhaemin Soi 2 and 4 where there is a residential and daytime shopping area; Community 2, "Soi 1". This community has had the strongest art and design district characteristics since 2000; Community 3, "Soi 9". This community is well-known as a dining spot. There are plenty of coffee shops, cafés and restaurants during the daytime and these convert themselves into bars at nighttime; Community 4, "Kantery Hills". This community consists of apartments and condominiums where there is new residential zoning; Community 5, "Soi 17". This area is another dining spot around Nimmanhaemin district. Each also has both daytime and nighttime function; Community 6, "Chiang Mai University's Government Officials residence". This area covers government officials' housing and apartments. An interesting point is that these communities are not related to the grid system on street network, but are connected by business types, social relations and old relationships.
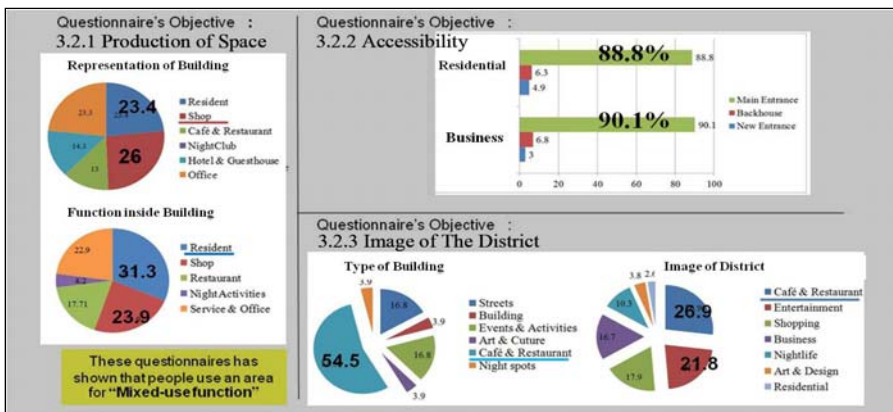
3.2 Field work: physical design

Figure 8. Questionnaire results: area use, accessibilities and image of district (March, 2014)

3.2.1 Production of spaces

From the questionnaires to analyse the area use, that data were combined. The type of buildings where people live and work is in shop-house (30.66%). Next are the apartments or condominiums (26.66%), followed by the new community plazas (25.33%). In addition, on average, 39% of buildings are classified as commercial (comprised of shops (26%),café/restaurants (13%), residential (23.4%) and offices (23.3%)). On the other hand, the functions inside those buildings are averaged for living (31.3%), commercial (23.9%) and office (22.9%). This data has shown that there are a variety functions which have tactics to convert residences into any business purpose flexibly in the same building. So, most of the buildings have "mixed use" functions.

3.2.2 Accessibility

This research divides accessibility into two kinds of functions, first is the residential function and second is for business function. The analyzed data are, first, accessibility for residential functions averaged as: 88.8% using the main entrance (existing access), 6.3% using the new entrance and

4.9% using back-of-house to access their own residence. Secondly, accessibility for business functions averaged as: 90.1% using the main entrance, 6.8% using the new entrance and 3.0% using a back-of-house entrance. These results show that most buildings use the main street for accessibility which has the highest density of traffic during daily rush hours.

3.2.3   Image of the District

From residents' questionnaires, the image of this district is a café and restaurant are (26.9%), entertainment area (21.8%) or a shopping district (17.9%). In addition, the most prevalent type of business is café and restaurant business (53.8%), followed by street (16.9%) and events (16.9%). As a result, this district is primarily viewed as a dining and entertainment area which is for business purposes. The area is no longer seen as a residential area, nor are there many residents, relative to the past.

3.3   Analysis "the production of space"

From the community groupings there appeared to be community groupings which do not relate permanently to a grid system as much as the government strategy dictates. Instead they have occurred due to business fostering and residential purposes. The government strategy is to use guide boards for commercial businesses in front of each Soi. This has shown that the government just sees this district as commercial zoning on a grid system *(Figure 9)*. As a result, research must focus on resident tactics.
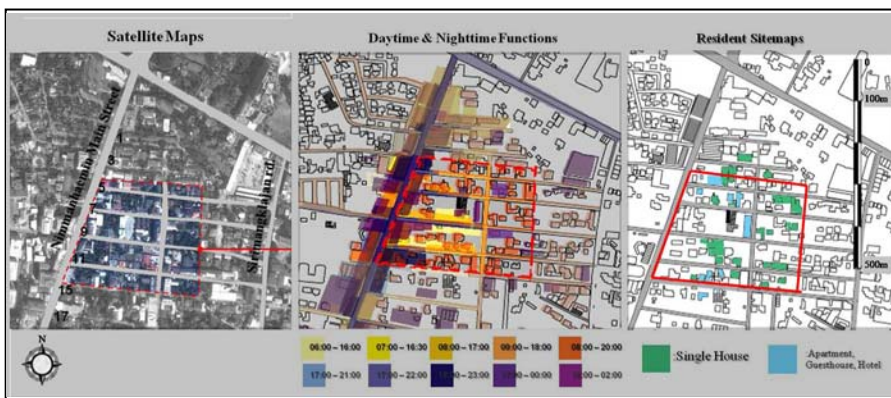

Figure 9. Comparison government strategy and present area use on sitemaps

To define "place" referring to the production of space theory, government strategy has planned Nimmanhaemin district as a business district which is posited on a street network. From this, there appeared a fostering of characteristics for each Soi, such as the art and culture district on Nimmanhaemin Soi 1 and the coffee shops' district on Nimmanhaemin Soi 9. Also, local government tried to announce each of them as shopping and dining spots by using guide boards fronted on the main street, though even through those strategies, it is hard to manage businesses growing following a government plan. Because of this, each street has not had much support for Small and Medium Enterprises (SME) and existing businesses. Other streets have also had plenty of coffee shops, but they have been unable to maintain their own businesses and profits, as much as for nightclubs and bars. For this reason it is hard to identify any Soi as having only one main characteristic, especially as no communities settled there originally.

According to areas on Nimmanhaemin Soi 5, 7, 9 and 11, residents have employed their own tactics to maintain their businesses and make their profit increase. On activities analysis, this study identified tactics including: converting old house, renovating shop-house, creating commercial courts, increasing night bars and new longitude community "condominiums". These tactics only aim to maintain business purposes, but do not rely on existing residents, therefore those kinds of areas could be redefined for "space" where it is flexible to meet users' perceptions and historical and present geography following the production of space theory.

Figure 10. Conflicts between residential & nightclubs on Nimmanhaemin Soi 9, 11, 13

4. SUMMARY: INTEGRATING "NEIGHBOURHOOD NETWORK"

Based on the analysis, an area surrounding Nimmanhaemin Soi 5, 7, 9 and 11 was chosen for further research as there have been conflicts between existing residents and nightclubs in this area regarding zoning. This area is overrun with and disturbed by noisy pollution, parking and traffic. With reference to related research, the attraction of this district is its great mixture of small-scale shops and activities, and is one of the liveliest hang out spots (Kulsrisombat 2008). For integrating "neighbourhood" concept, this district must first manage its zoning. "Physical Design" is the way to steer this area towards a community focus. This research presents applicable solutions for zoning between residential and other businesses in this area. These applications will improve thoroughfares and the atmosphere in this district. In particular, current problems such as traffic jams, parking and zoning need to be solved. In addition, "Social Interaction" is required to support settling a community. This research suggests new regulations to control new investments and buildings around this district. These regulations will lead to the creation of an image for this district. Moreover, residents and other users will be a part of the community by participating in annual events and through volunteer activities.

4.1 Application for "physical design"

Referring to related research, Nimmanhaemin residents agree with the residents of Chiang Mai city communities that there should be no expansion of roads in the walled town of the old city, not only because road-building there would add to, rather than solve, traffic problems, but because it would also destroy their city's unique characteristics (Sirorod and

`Ongsavangchai,2012`. Because of this, this research gives solutions for managing complexities between residential and business purposes. This research posits the creation of a pedestrian route which connects to business communities and also manages zoning for residential areas. From surveying existing business communities in the area disconnected pathways and pedestrian areas which connect to Nimmanhaemin's main street have been found to be lacking. This reason prevents businesses inside each Soi of Nimmanhaemin District from gaining as much profit as they could and also results in complexity between areas with both residential and business purposes.

4.1.1   Pedestrian route connected business communities

This research presents an idea for managing traffic on the odd numbered Sois by creating permanent walking routes which connect to Nimmanhaemin's main street, existing business communities and nearby Sirimanklajan Street. This route would be presented on the neighbourhood relations' sitemap. Accordingly, along the new pedestrian route, along with pavements, there should also be support for one-way traffic for cars, as well as a bicycle lane and also divided users' routes from resident zones (*Figure 11*).

Figure 11. Physic design for zoning of areas with residential and business purposes

4.1.2   Natural boundary for residential and business purposes

Following World Health Organization (WHO) recommendations, there is a recommended standard ratio for green areas in a city of 9 Sq.m./person. On the other hand, the Department of Public Works and Town and Country Planning of Thailand states the recommended ratio of green area at just 2.88 Sq.m./person. From Chiang Mai City Surveying during 2012-2013, Chiang Mai City (Muang District) has an overall green area of 1.28 Sq.km and the ratio of green area in Chiang Mai City has been calculated as 5.77 Sq.m./person `(CRUCMU (2014))`. Because of this, an important issue for urban management in sustainable cities is to satisfy the ratio of green area per person as suggested by the WHO's standard. From site surveying, residents use natural boundaries as a buffer for visual pollution from outside and nightclub noise pollution. For improving the physical design, this research supports that idea and includes natural boundaries to separate resident areas from business areas, especially nightclubs and bars, in its suggested planning solution. Natural boundaries would include planting trees along the street for blocking visual and noise pollution from other businesses. This would be a sustainable way to add to this district's 'green' atmosphere and would divide zones currently lacking physical barriers. In

addition, these natural boundaries would create sunshade for people who walk along the pavement. Adding more green areas makes the image of the district more local and creative, as it used to be in the past (*Figure 12*).
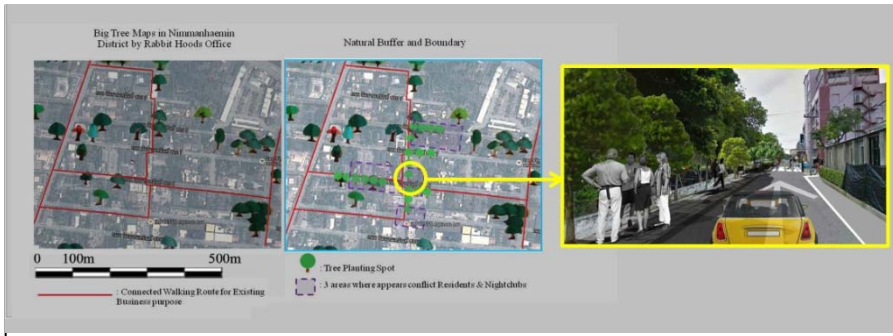

Figure 12. Natural boundary planning

New pedestrian areas and natural boundaries should direct people who follow those routes to business communities and connect residents' areas together. This plan for zones would allow areas with business purposes to smoothly blend in with areas with residential purposes. This physical design provides for three residential zones following the suggested planning solution (*Figure 13*).
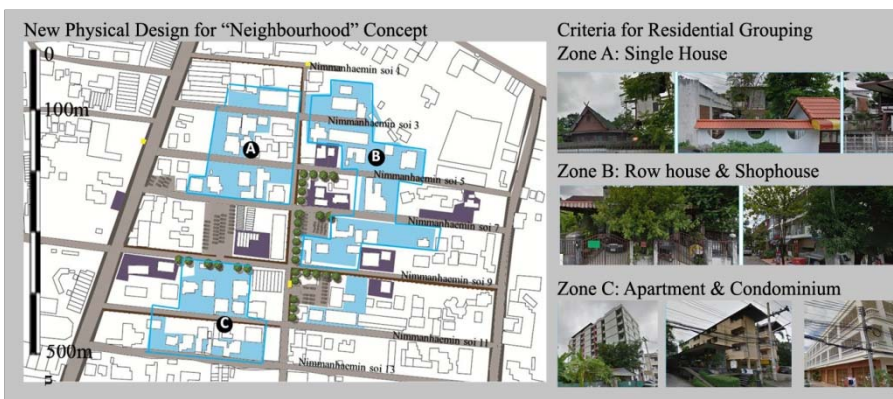

Figure 13. New Physical Design for "Neighborhood" Network

4.2　　**Regulation for supporting social interaction**

Three residential zones are to be divided based on building types considering their history and new geography (physical design). Those areas are then controlled depending on business types and should adhere to new regulations posited based on questionnaire results.

Zone A - "Single House": This area covers single houses around the west side of Nimmanhaemin Soi 3, 5 and 7 where single houses continue to be maintained. Buildings in this area are old single house's whose images represent original 80th century architecture.

Regulations for Businesses in Zone A: Businesses in Community A represent friendly atmosphere that blends with the old housing context. Existing businesses in this area are good examples for new businesses to follow within this context. Businesses are converted single houses such as coffee shops, restaurants and shops. In addition, these represent single houses which fit in with the nearby context. Most of them are using tactics to gain more profit as they are a part of the local representation of the area and take advantage of their original buildings.

Zone B - "Row-house and Shop-house": In this area, there is a variety of residential buildings, such as single houses, row-houses, shop-houses and apartments, with most being row-houses and shop-houses. In the original row-houses and shop-houses there is only one façade with shared construction and walls shared with neighbouring units. This community is divided into shop-house groupings and row-house groupings, but the strength of the character around this area is in its division by units which relate to a grid system and street networks.

Regulations for Businesses in Zone B: With modern development, each unit seeks to be outstanding, and also from a business perspective. Lots of businesses in this area have renovated shop-house units for making businesses purposes. Most of them use the tactic to attract people by designing façades and interior design dependent on the activities of the shop and the owner's ideas.
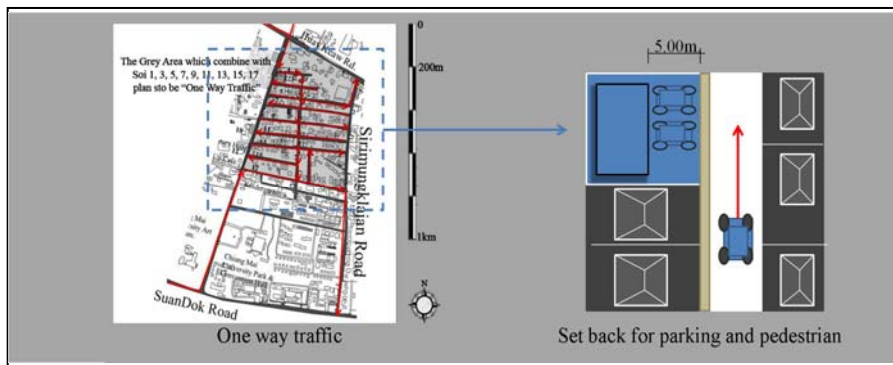

Figure 14. Zone C "Apartment & Condominium"

Zone C - "Apartment and Condominium": In these areas, many sections are already either planned for or developed as apartments and condominiums. With the potential of public facilities and business gains, there has been a rapid increase of condominiums.

New Regulations for Businesses in Zone C: Without limits and controls, condominiums are built without a corresponding strategy and are randomly designed just for business gains. The suggested regulations for this zone are:

Traffic circulation on Soi 1, 3, 5, 7, 9, 11, 13, 15 and 17 is controlled with one-way traffic management for solving traffic jams and parking problems.

Apartments and condominiums in Zone C have to be setback from the street more than 5m to accommodate their own parking and drop-off areas.

Nightclubs must close before midnight and not disturb neighbours with excessive noise.

New apartments and condominiums in Zone C have legal height limits of up to 12m, following the government strategy for not blocking views of Suthep Mountain and possibility disturbing Air Plane Transportation

Apartments and condominiums in this community grouping should have legally controlled façades and elevations which are not too diverse or could possibly lead to a visually unattractive community; the façades and elevations should be accepted by the community.
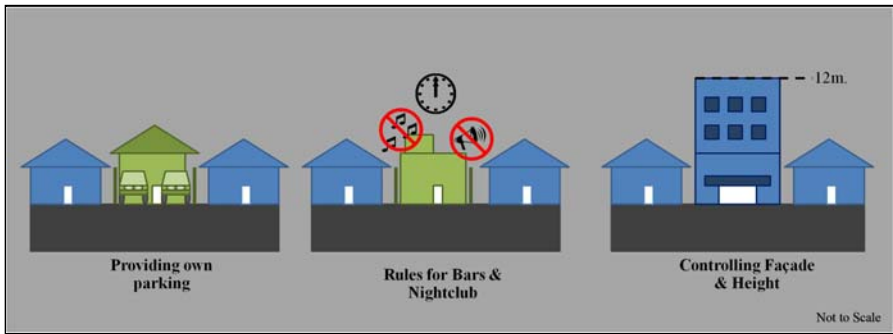
Figure 15. Zone C "Apartment & Condominium"

4.2.1 Integrating public circulation

This research assessed that physical design on this case could possibility be designed to make neighbourhood networks by creating nodes which would be able to accommodate activities promoting public thoroughfare connectivity. In order to create nodes for neighborhood networks, this research proposes a center for each community to connect residences. These areas lack public spaces in the community centre, such as a temple or religious statue, playground or park.

A questionnaire with residents collected information about residents' behaviours regarding the use of community facilities and everyday life (See Figure 16). That data has shown that residents share the same amenities around the main street, like the supermarket, convenient stores and banks. Those buildings could provide common areas for residents' daily use. From this hypothesis, the researcher posits that those amenities along the main street should provide a public area for common use, the centre of this community, would then be in the area where convenient stores and shops are located, in front of Nimmanhaemin Street Soi 6-8.
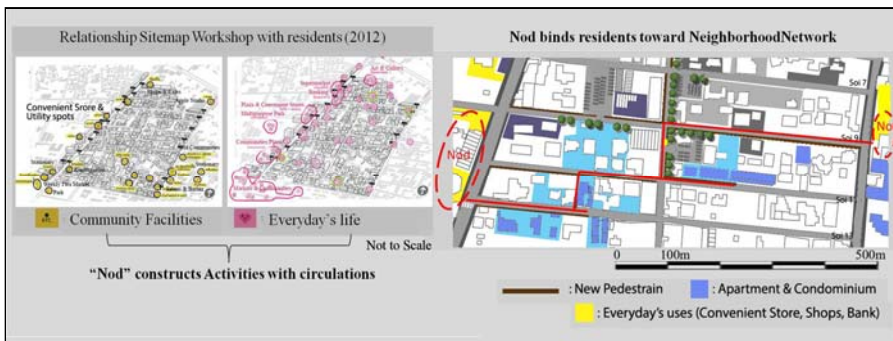

Figure 16. Communities' facilities (yellow) and everyday's Life (pink) on Sitemap (2012)

From an apartment unit to a public space, every resident has to exit from the apartment's first floor, therefore, the first floor of each apartment is an area in between public and private space. Apartments are designed for privacy and are closed, but that leads to residents lacking social interactions. This research presents an idea for connecting thoroughfares from each apartment as a communal route. This communal route should bind all residents with social interactions and connect them with amenities (at the centre of the community). Therefore, this thoroughfare will connect residents and bind them at nodes, which allows for activities and thoroughfares to be created following the "Neighborhood Network" hypothesis as well.

4.2.2   Events for supporting Social Interactions

On Soi 1, 4 and 9, the Nimmanhaein district officially holds annual events which represent their own images and communities. Soi 1 has held "NAP (Nimmanahaemin Art and Design Promenade)" on the first week of every December since 1999, Soi 4 also advantages from that event by holding a flea market during the same time, and Soi 9 has held its annual Songkran Festival since 2013.

Apartment communities on Soi 9, 11 and 13 are primarily residential. Social interactions for these communities come in two stages. The first important stage is to announce this area as a "Community" and hold a meeting for managing apartment representatives. Secondly, social interactions will eventuate from creating nodes. For supporting the minds and relationships of residents, social interaction should be created with mainly residents in mind. There is the possibility of holding a "Big Cleaning Day" annual event (All residents come and clean the public areas within communities) or an "Open House" flea market event (All residents share and sell their used items).

5.   ACADEMIC CONTRIBUTION

Chiang Mai itself continues to grow rapidly without directions and a cutthroat business ethic is all too evident. The authors aim for this research to maintain and drive the Nimmanhaemin community as a creative district. A summary of the research follows.

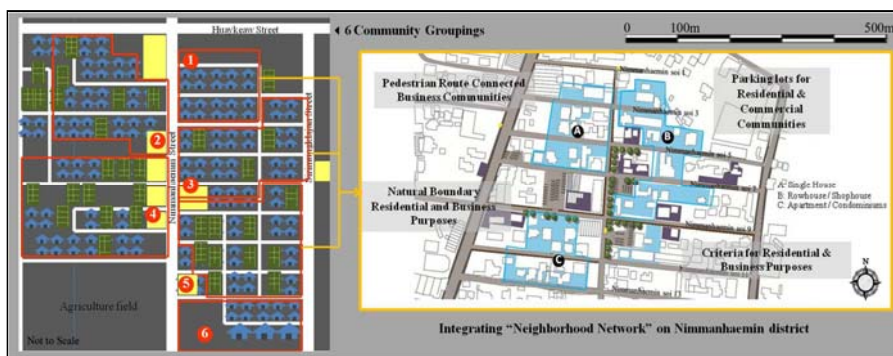## 5.1   Community grouping on Modernity Planning

Figure 17. Community grouping on modern planning, a case of Nimmanhaemin District

Regarding the latest research in 2014, Chiang Mai City has been invested in for new business projects, including 74 condominiums, 18 mega projects and 28 superstores. This data shows how residential areas are the most invested in areas of the city, where there is support for public facilities and related offices (CRUCMU (2014)). A community has to posit healthy networks. In the case of Nimmanhaemin district, this district has no cultural history and was originally planned for real estate following a grid system; however communities presently are not bound by a grid system. In addition, the number of high-rise residential and mixed-use properties has been increasing (*Figure 17*). Surveying the communities, there appeared many controversies about disturbances and zoning between existing residents and new investors. Modern planning supports private transportation and real estate for achieving business aims. Urban re-management is important to

create better situations for existing residents and investigators. An interesting point is that geography cannot be the only factor considered in order to claim those areas as one single community. From questionnaire results and site surveying, area uses and social relations are also identified as important issues for analysing community groupings. This result supports Nicholas N. and Patricios's "Neighbourhood" concept, which is a retrospective concept of physical design and social interaction.
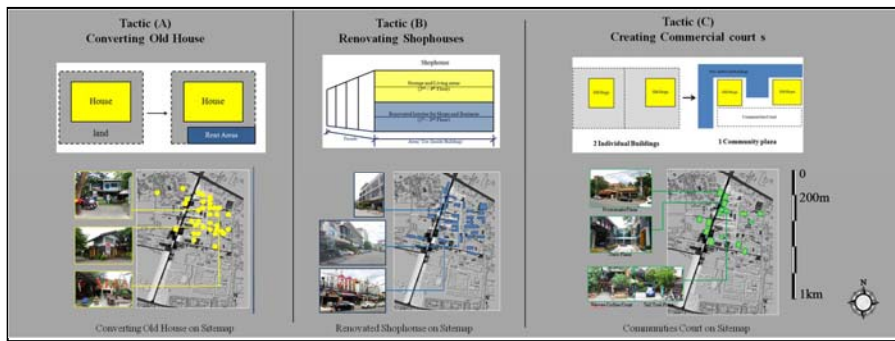
5.2 Regulation related to current area uses

Figure 18. Various area uses in Nimmanhaemin District

Regulation is a government tool for controlling area uses. Nowadays, regulations have not been updated to concern existing residential properties. Research results have shown that area uses are flexible and follow user purposes. This research studied the relationship between present regulations and the current problems communities face in order to suggest updates to community regulations. Regarding Henri Lefebvre's 'Production of Space' theory, he describes that any area is defined by its "Place and Space" and concerns the area's uses. Place is an area defined by Government from a single perspective, but according to research results, many areas and businesses around this district have evolved and gained various purposes which relate to the "Space" definition. Many buildings in the Nimmanhaemin district try to survive and take advantage of the changing space by altering the context of their businesses, such as converting old houses to shops, renovating shop-houses to suit other kinds of business and multiple businesses connecting together to form plaza areas (*Figure 18*). Therefore, no regulations have been designed to last and they are required to adjust to the changing actions of residents and present area uses in each community grouping, on a case by case basis. Government should study and concentrate on current area uses in order to update regulation.

This research's aim is to integrate "Neighbourhood" into this complexly zoned area by means of practical solutions, positing new community groupings, developing physical design and supporting social interactions. These solutions were posited from research based on the "Production of Space" and defining of "Neighbourhood" theories. This research is one of many studies for settling communities sustainably and promoting urban regeneration. Especially in developing countries, there are many complex areas caused by modern thought's urban planning. Without maintaining existing communities, urban regeneration cannot be successfully suited with existing residential stakeholders. A strategy should be formed and developed based on a community focused approach.

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