Cities within cities:

An examination of urban space use and transformation in ancient and modern times

PhD Thesis

Yan Gu

TECHNISCHEN UNIVERSITÄT MÜNCHEN
Fakultät Architektur

Cities within cities: An examination of urban space use and transformation in ancient and modern times

Yan Gu

Vollständiger Abdruck der von der Fakultät für Architektur der Technischen Universität München zur Erlangung des akademischen Grades eines Doktor-Ingenieurs genehmigten Dissertation.

Vorsitzender: Prof. Mark Michaeli

Prüfer der Dissertation:

1. Prof. Dr. Dr.h.c. Thomas Herzog
2. Prof. Peter Latz
3. Prof. Dr. Mao Qi-Zhi (Tsinghua University)

Die Dissertation wurde am 06. 07. 2020 bei der Technischen Universität München eingereicht und durch die Fakultät für Architektur am 22. 12. 2020 angenommen.

Anhang I
Eidesstattliche Erklärung

Ich erkläre an Eides statt, dass icch die bei der promotionsführenden Einrichtung

Fakultät für Architektur

der TUM zur Promotionsprüfung vorgelegte Arbeit mit dem Titel:

Cities within Cities: an examination of urban space use and transformation in ancient and modern times

in Fakultät für Architektur

Fakultät, Institut, Lehrstuhl, Klinik, Krankenhaus, Abteilung

unter der Anleitung und Betreuung durch: Prof. Thomas Herzog ohne sonstige Hilfe erstellt und bei der Abfassung nur die gemäß § 6 Ab. 6 und 7 Satz 2 angebotenen Hilfsmittel benutzt habe.

☒ Ich habe keine Organisation eingeschaltet, die gegen Entgelt Betreuerinnen und Betreuer für die Anfertigung von Dissertationen sucht, oder die mir obliegenden Pflichten hinsichtlich der Prüfungsleistungen für mich ganz oder teil- weise erledigt.

☒ Ich habe die Dissertation in dieser oder ähnlicher Form in keinem anderen Prüfungsverfahren als Prüfungsleistung vorgelegt.

☐ Die vollständige Dissertation wurde in___________veröffentlicht. Die promotionsführende Einrichtung

____

hat der Veröffentlichung zugestimmt.

☒ Ich habe den angestrebten Doktorgrad noch nicht erworben und bin nicht in einem früheren Promotionsverfahren für den angestrebten Doktorgrad endgültig gescheitert.

☐ Ich habe bereits am____________________bei der Fakultät für ___________________________________

der Hochschule____

unter Vorlage einer Dissertation mit dem Thema____________________________________

die Zulassung zur Promotion beantragt mit dem Ergebnis:____________________________________

Die öffentlich zugängliche Promotionsordnung der TUM ist mir bekannt, insbesondere habe ich die Bedeutung von § 28 (Nichtigkeit der Promotion) und § 29 (Entzug des Doktorgrades) zur Kenntnis genommen. Ich bin mir der Konsequenzen einer falschen Eidesstattlichen Erklärung bewusst.

Mit der Aufnahme meiner personenbezogenen Daten in die Alumni-Datei bei der TUM bin ich

☒ einverstanden, ☐ nicht einverstanden.

____

Munich , , Unterschrift

Cities within cities:

An examination of urban space use and transformation in ancient and modern times

Yan Gu

" Know thyself "

Temple of Apollo at Delphi

Acknowledgement

This empirical research benefits from the help of scholars in architecture, urban and landscape planning, geography, Socio-Economics, linguistics as well as history and archaeology. In addition, the supports from other people also contribute to my work. I would like to take this opportunity to express my appreciation to each of the individuals and institutes aiding me in my academic exploration.

In the beginning, I would express my earnest appreciation for my first supervisor Prof. Dr. Thomas Herzog. I did benefit significantly from his indications regarding research methodology. Moreover, Professor Herzog's thinking has given me more power and spirit to progress in the research writing. I also have to thank my associate supervisors Prof. Peter Latz and Prof. Dr. Mao Qi-Zhi for all the support and encouragement they gave me. Without their guidance and feedback this PhD would not have been achievable.

Apart from my supervisors, I won't forget to express the gratitude to Prof. Dr. Long Ying in Tsinghua University and Beijing City Lab (BCL) as well as Prof. Dr. Wang She-Jiao in Northwest Institute of Historical Environment and Socio-Economic Development (China). Benefited from their help, I probe into case studies about the socio-spatial interaction in ancient Changan and modern Beijing based on quantitative analysis. I greatly appreciate the support from Prof. Mark Michaeli for proposals on my research and efforts to manage my dissertation defence.

I am also pleased to say thank you to Prof. Dr. Roland Altenburger, Dr. Zhang Wei, Asst.-Prof. Dr. Zhao Juan-Juan, Dr. Stephen Starck, Dr. Dai Peng, Dr. Yan Wei, Dr. Fei Teng, Mr. Liu Jian, Mr. Zhang Hao-Tian, Mr. Yao Yan-Jv, Mr. Wang Yan-Jun and Mr. Zhang Tian-Yu. Their constructive comments and warm encouragement make enormous contribution to mcy work in Germany. Except for that, I gratefully acknowledge the funding received towards my PhD from the China Scholarship Council.

Last but not the least, I am grateful to my family, friends and acquaintances for their support to my efforts on the scientific road for pursuit of truth. Particularly, their long-term patience with me also promotes my strengths to confront challenges and stick to the goal.

Summary

This dissertation analyses the phenomenon of a city within a city (CIC) in China, which integrates the interdisciplinary approaches in urban planning, socio-spatial governance and big data analysis. In particular, the palace CICs in the pre-1949 era and modern CICs constructed by work units in Beijing are examined and compared to other types of CICs and gated communities in China as well as other parts of the world.

The design of the ancient palace cities for the ruling classes were influenced by the collectivist life style which integrated state governance and royal life within enclosure-gating systems. The construction of modern CICs for work units, with a broader social mix, were also influenced by collectivist life style. The work unit CICs, accommodating a large population through collective management integrating working and living, has become a social product influenced by the Chinese tradition of collective management as well as the independent jurisdiction in urban and rural areas due to a multi-levels' bureaucracy. To some extent, the collective life style of production and consumption in rural areas and enclosure-gating system of palace cities are transformed and integrated into the establishment of modern CICs after 1949.

To elaborate on the lineage of CICs in Chinese ancient history and their differences from modern CICs with regard to land use and population management, I analyse archaeological findings and compare CICs from different dynasties. I also probe into the genesis of palace CICs as well as their development. Additionally, I explore the development and transformation of modern CICs after 1949, combining field studies and big data analytics to uncover the mechanisms for the internal space management of CICs and external services developed in fragmented CIC boundary spaces. However, these boundary spaces still function as "thick" walls between CIC inner spaces and the surrounding citizens. In addition, through interviews with scholars, CIC managers as well as other individuals living and working inside modern CICs, the analysis of real-time space use vitality and balance based on big data analysis includes the local experiences inside CICs and demands for better quality of life.

As a response to previous contrasting views proposed by scholars on the future prospects of modern CICs, I explore the urban vitality and space use balance as well as the land use mix and spatial permeability to reveal the present-day urban life inside modern CICs in Beijing. cOn the other hand, how the enterprise CICs that were on the verge of bankruptcy and lost workers became hubs for emerging industries is also investigated.

In conclusion, this dissertation contributes to expanding the urban study theories and methods to reveal the urban vitality by examining the real-time space use, low permeability and land use mix with fine grain. Moreover, the examination of CICs reveals the origin and development of the mechanism for integrated production and consumption based on independent governance to enliven the urban life within enclosures of present day urban Beijing.

Zusammenfassung

Diese Dissertation analysiert das Phänomen einer Stadt in der Stadt (CIC) in China, das die interdisziplinären Ansätze der Stadtplanung, der sozialräumlichen Governance und der Big-Data-Analyse zusammenführt. Insbesondere werden die Palast-CICs in der Zeit vor 1949 und die modernen CICs, die von Arbeitseinheiten in Peking gebaut wurden, untersucht; es steht außerdem ein Vergleich mit anderen Arten von CICs und Gated Communities in China sowie in anderen Teilen der Welt an.

Das Design der antiken Palaststädte für die herrschenden Klassen wurde durch den kollektivistischen Lebensstil beeinflusst, der die Staatsführung und das königliche Leben innerhalb von Einfriedungs-Gatesystemen integrierte. Der Bau moderner CICs für Arbeitseinheiten, mit einer breiteren sozialen Mischung, wurde ebenfalls vom kollektivistischen Lebensstil beeinflusst. Die CICs für Arbeitseinheiten, die eine große Bevölkerung durch kollektives Management unterbringen, das Arbeiten und Leben integriert, sind ein soziales Produkt geworden, das von der chinesischen Tradition des kollektiven Managements sowie der unabhängigen Rechtsprechung in städtischen und ländlichen Gebieten aufgrund einer mehrstufigen Bürokratie beeinflusst wurde. Bis zu einem gewissen Grad werden die kollektive Lebensweise der Produktion und des Konsums in ländlichen Gebieten und das Einfriedungs-System der Palaststädte transformiert und in die Einrichtung moderner CICs nach 1949 eingebunden.

Um die Abstammung der CICs in der alten chinesischen Geschichte und ihre Unterschiede zu den modernen CICs in Bezug auf Landnutzung und Bevölkerungsmanagement herauszuarbeiten, analysiere ich archäologische Funde und vergleiche CICs aus verschiedenen Dynastien. Ich untersuche auch die Genese von Palast-CICs sowie deren Entwicklung. Darüber hinaus untersuche ich die Entwicklung und Transformation moderner CICs nach 1949, indem ich Feldstudien mit Big-Data-Analysen kombiniere, um die Mechanismen für das interne Raummanagement der CICs und externe Dienstleistungen aufzudecken, die in fragmentierten CIC-Grenzräumen entwickelt wurden. Diese Grenzräume fungieren jedoch noch immer als "dicke" Mauern zwischen den CIC-Innenräumen und den umliegenden Bürgern. Durch Interviews mit Wissenschaftlern, CIC-Managern sowie anderen Personen, die in modernen CICs leben und arbeiten, umfasst die Analyse der Echtzeit-Raumnutzungsvitalität und -balance auf der Grundlage von Big-Data-Analysen auch die lokalen Erfahrungen innerhalb der CICs und die Anforderungen an eine bessere Lebensqualität.

Als Antwort auf frühere gegensätzliche Ansichten von Wissenschaftlern über die Zukunftsaussichten moderner CICs untersuche ich die urbane Vitalität und das Raumnutzungsgleichgewicht sowie den Flächennutzungsmix und die räumliche Durchlässigkeit, um das gegenwärtige urbane Leben innerhalb moderner CICs in Peking aufzuzeigen. Durch die Untersuchung der Raumnutzung und Transformation moderner CICs mit hoher Bevölkerungsdichte, stellt diese Dissertation gleichzeitig dar, wie die sozialräumliche Mischung und das unabhängige Management der CICs das Raumnutzungsgleichgewicht in diesen gut entwickelten Campus-CICs fördern. Andererseits wird auch untersucht, wie die Unternehmens-CICs, die am Rande des Konkurses standen und Arbeitskräfte verloren, zu Drehscheiben für aufstrebende Industrien wurden.

Zusammenfassend trägt diese Dissertation dazu bei, die Theorien und Methoden der Stadtforschung zu erweitern, um die urbane Vitalität durch die Untersuchung der Echtzeit-Raumnutzung, der geringen Durchlässigkeit und der Landnutzungsmischung mit feiner Körnung aufzudecken. Darüber hinaus offenbart die Untersuchung der CICs den Ursprung und die Entwicklung des Mechanismus für integrierte Produktion und Konsum auf der Grundlage unabhängiger Governance, um das urbane Leben innerhalb der Umzäunungen des heutigen städtischen Peking zu beleben.

Contents

List of Figures

List of Tables

List of Abbreviations

BIT	Beijing Institute of Technology
BJFU	Beijing Forestry University
BJTU	Beijing Jiaotong University
BLCU	Beijing Language and Culture University
BNU	Beijing Normal Univsrsity
BUAA	Beijing University of Aeronautics and Astronautics
BUPT	Beijing University of Posts and Telecommunications
CAU	China Agricultural University
CCP	Chinese Communist Party
CIC	City within a city
CUGB	China University of Geosciences, Beijing
CUMTB	China University of Mining and Technology, Beijing
DPMHA	Daily proportion of merged high-density areas
KMT	Kuo Min Tang (Party)
LME	Large and medium-sized enterprises
MUC	Minzu University of China
PKU	Peking University
PRHA	Proportion of real-time high-density areas
PUHSC	Peking University Health Science Centre
RC	Residents' Committee
RMU	Renmin University
STID	Spatiotemporal integration degree (between CIC and public)
SME	Small and medium-sized enterprise
SO	Street Office
THU	Tsinghua University
USTB	University of Science and Technology Beijing

Chapter I

INTRODUCTION

1 Introduction

1.1 The concepts from "city" to "city within a city (CIC)"

1.1.1 City: start from the settlement with mixed land uses and a dense population.

The density, function and activity, were always mentioned as common attributes to describe the spatial identities of a city. The past 5000 years' history have made city an important "landscape" (Smith, 1989) based on the demographic and functional definitions of the city from archaeologists and historians. For Wirth (1938), the city is defined as a large, dense, and permanent settlement with heterogeneous individuals. The fixed and floating population from different social divisions and geographical regions constitute a more complex city life than that in the rural areas. Wirth's definition of city relies heavily on the demographic characteristics. In addition, Smith et al. (2014) stressed the functional definition of a city from an economic perspective. No matter how large the population is, various of economic functions should be fulfilled in a city (Smith, 1989). More specifically, the central place theory introduced that the retail and service functions made the city a centre to influence its surrounding areas (Berry, 1964, Harris and Ullman, 1945, Christaller, 1966). Additionally, the description of the city development from urban ideology, economic exchange, political control, industrial production and colonial dependency, etc. (Fox, 1977) expands the definition of the city by including the consideration of increasingly complexed social backgrounds.

The concept of a city in architecture and urban planning is also based on empirical research findings and analyses by integrating the viewpoints of archaeology and the theories of modern urban life. As described in the article of Lewis Mumford (2011): "The city is a related collection of primary groups and purposive associations: the first, like family and neighbourhood, are common to all communities, while the second are especially characteristic of city life." Then Mumford emphasized that the social division of labour supports the economy and culture. Lynch (1984) described the city as "a quantitative distribution of workplaces and living places". Kostof and Norwich (1993) further believed that a prehistorical city had the clear division of labour as well as different social ranks. They pointed out that the city in the beginning was a place for assembling people in social activities, which is not related to absolute size or number but connected with the density of settlements.

In current urban governance, the specific characteristic of population density is used to distinguish between city and rural areas (Ritchie and Roser, 2018, Pateman, 2011, Cromartie and Bucholtz, 2008, Pryor, 1968). For example, the analysis of population density with demographic data offers announcement for different countries to define basic criteria for identifying an administrative city. With harmonised spatial concepts, Dijkstra and Poelman (2014) classified the degree of urbanization into three levels: densely-populated areas, intermediate-populated areas and thinly-populated areas. Furthermore, only the thinly-populated areas are considered the rural area and the other types are classified to the urban areas. Moreover, the densely populated urban areas with an centre with at least 1,500 people per km^2 and also with a population not less than 50,000 will be recognized as cities (Dijkstra and Poelman, 2014). For modern China, the city should be designated by the state council with a population density criteria of 1500 people or higher per km^2 (Demographic Yearbook, 2007).

Based on the above understandings, the attributes of community life with a certain density and a functional mix can be applied as codes for defining and describing cities. In this dissertation, the majority of the study cases functioned as regional political, economic and military centres in the history of China. Moreover, there is the special phenomenon of city within the city (CIC) appearing in most of the selected cities. Even though many ancient Chinese cities are only the ruins, an exploration spanning different periods will link between the development and transformation of CICs in China. The transition of CIC from agricultural society to modern society has been completed within the recent 70 years' history. For the extant well-functioning modern CICs mainly in Beijing, this study will examine their space use and transformation in the radically changed social background.

1.1.2 What is a CIC in China?

The earliest city constructed in ancient China experienced the Neolithic society to "three dynasties" (Xia[1], Shang and Zhou). During this period, within the outer city, the king city / royal city / palace city were built as gated compounds for ruling classes. The archaeological discovery of ancient city ruins in Xian (known as Chang'an[2] before Ming dynasty) and Luoyang revealed the existence of gated inner cities which also functioned as CICs of the royalty and their servants / guards. In the past, capital cities were always built with one or more inner palace cities combining the functions of living, working, and service. The early CICs in China symbolized the highest social hierarchy as well as the highest security of urban spaces within walls.

Lynch (1981) claimed that the city has "a long-term historical sequence" as do CICs in China (Wu, 2005, Ma and Wu, 2005). Their socio-spatial continuity and transformation from the ancient Chinese period to modern times are explored in this dissertation. After the founding of People's Republic of China in 1949, many gated work units were established to develop the national industries. Most of them were located around the old urban centres. These work units were responsible for supporting the public welfare and public services including housing, food, health care, cultural, sport and entertainment facilities with self-sufficiency (Whyte and Parish, 1985, Walder, 1986, Zhou, 2000, Gaubatz, 1999, Huang, 2006) because of the lack of urban public services that should have been provided by the central government (Bray, 2005, Lu, 2006). The independent governance in CICs also matured during this period (Gu et al., 2019). Within enclosures and gating systems, every work unit functioned as a city (Ma and Wu, 2005) with collective life for the colleagues, their families as well as students. The urban sprawl quickly transformed these work units, which also contributed to the formation of modern CICs in urban China. In ancient China, the palace CIC functioned as the housing for nobility and as the centre for state dominance. During industrialization of China after 1949, modern CICs built by work units constitute the basic urban cells for organizing the citizens' daily lives (Bray,

[1] Indeed, some scholars argue that the Xia dynasty and Shang dynasty was the same dynasty, because there have not been archaeological evidences of character "Xia" 夏 in oracle bone script to prove the existence of Xia dynasty yet. In contrast, the records of Xia dynasty could be found in the literatures written in Zhou dynasty. The conflict between the lack of empirical findings and the historical records will not interfere with our study on city within the city (CIC) of China.

[2] The name of ancient cities in China will be split by single quote (') between two syllables.

2005) and serve for the social and industrial production. On the other hand, the walls, fences and buildings on the boundaries of these work units segregate their CICs from the outside urban public. The physical interaction between the work unit and the outside public can only be realized by passing through the gates on the CIC boundary. The enclosure and gating system could also be considered one of the prominent spatial features of the Chinese CIC.

Many scholars focus on the formation of work units after 1949 and on their decline and transformation after 1978. For the period between 1949 and 1978, many studies examine the reason why and how the work units formed the modern CIC life style. Between the Chinese collectivist tradition and the soviet "socialist condenser" practice, scholars argue about which one influenced more greatly on the formation of work unit system to integrate the job and housing. In contrast, other studies on the work units during the Chinese economy reform after 1978 mainly focus on the impact of a market based economy on the deconstruction/transformation of work units, especially those enterprises which could not support collective living and working inside CICs. In addition to the decline of some CICs after 1978, simultaneously, some other modern CICs developed and expanded their territories and populations flourished, both of which are explored with empirical findings in this dissertation.

Due to the public critiques of the spatial enclosures and gating systems of CICs in the economic reform after 1978, scholars argued about how to open and share spaces within CICs with the public. The large-scale of CIC enclosures created obstacles to develop a dense urban road system and those CICs are blamed for causing the heavy urban congestion (Zhao, 2006c). Zhang (2004) proposed utilizing the commercial power to transfer and integrate the CIC spaces into the urban public environments. However, few studies focus on the real-time utilization of the CIC spaces. Bray (2005) also wrote that studying life inside the work unit matters, which also suggests the demands of examining into the CIC phenomenon. A further exploration of the life inside CICs to comprehend the requirements of the CIC members for protecting the enclosures and gates will contribute to figure out the hidden reasons of current obstacles for CICs to create a permeable urban environment. Hence, the space use within modern CICs will be explored in this dissertation.

Though the enclosure and gating system on the boundary and the inside land use mix constitute the main physical traits of CICs in China, the changes from agricultural society to industrial society as well as the changes from central planned economy to market based economy determined the construction and transformation of the spatial function within CICs. Therefore, there are four types of CICs based on their diversified socio-spatial functions in different eras of China. In ancient China, there were two types of CICs. One was the imperial/palace city for ruling classes. The other one was the inner city produced in the urban expansion due to growing urban populations. CICs produced in modern China are also classified into two types. The other two types of CICs appear in modern China. One is the cultural heritage town and the other one is the work unit built after 1949. The heritage CICs are similar to the ancient inner city because both were produced due to large increasing in their urban population. In contrast, modern CICs for work units and ancient palace CICs have the collective living and working structures, which make them typical Chinese CICs, but they maintained totally different social relationships/interactions. The modern CICs in China are distinctive from other CICs because of the space use mechanism with an egalitarian, socio-spatial mix and self-sufficiency, the exploration and evaluation of which will be the main focus of this dissertation.

The modern CICs in China also have experienced a variety of changes in a quickly transformed social background during the past 70 years. Some CICs still have strong social ties between their space users. For example, those campus CICs benefit from the economic reform and policy support to expand the student population and campus territory. In those transformed enterprise CICs, the individuals in different companies have weaker social connections due to the destruction of self-contained collective life after the enterprise reform starting in the 1990s. The development and transformation of modern CICs further provide a point of comparison for uncovering the space use/transformation mechanism. The contributions of this dissertation to theoretical studies and planning practice in the modern epoch will also be summarized based on empirical case studies. In this dissertation, the lineage exploration of ancient CICs in those historical capital cities will uncover the slight changes of space use mechanisms in ancient agricultural China. More importantly, the work units for universities and enterprises located in Beijing will be selected based on their representative attributes to reveal the development and transformation mechanisms of modern CICs.

1.2 The rediscovery of Chinese CIC deserves our attention in nowadays

1.2.1 Is the CIC concept in China generally the same as that in other parts of the world? Distinguish the concepts of CICs in different regions and periods of the world.

When people think about walled cities, it will remind them the medieval cities which also had city walls and gating systems (Gruber and Angerer, 1952, Pirenne, 2014, Nicholas, 2014). Unlike European medieval cities where multi-story stone buildings supported a high population density, the Chinese cities built during the same period developed huge and flat enclosed spaces filled with wooden buildings to support a lower population density. To some extent, the limits of wooden constructions in China contributed to the horizontal development of medieval cities. In China, palace cities or imperial cities within large-scale enclosures, functioning as CICs, started the tradition of constructing double or triple walled systems within ancient capital cities. During the medieval time, the upper classes lived in Europe palaces/castles as well as Chinese palace/royal cities within the urban areas. Moreover, the enclosed collective tradition with highly complex functions and large populations (about 20~40 thousand people) including the royalty, government officers and their servants/guards constituted the main features of typical Chinese CICs before 1949. The functional mix included imperial court, council of ministers, archives and libraries for national governance, gardens, theatres and sports fields for entertainment; as well as medical service, imperial kitchen and housing for above populations living inside imperial/palace cities, where almost everything for a collective CIC life had been integrated. However, many of the female members were tied within these CICs for almost their whole lives and the social hierarchy between each member in CICs was also extremely rigid. Furthermore, due to the existence of walls and gates, for the other normal citizens of the capital cities, the lives inside imperial/palace cities were mysterious and untouchable.

When China developed an industrial society after 1949, some old towns and most modern work units developed spatial enclosures/gates and also experienced deep social transformations. The quick urbanization process transformed them into CICs. Moreover, the 1978 economic reform increased the differences of their socio-spatial development. In contrast, to other parts of the world scholars use the CIC concepts to refer to the social inequity and stratification produced by invisible city walls. The social discrimination and spatial segregation produced "CICs" in western societies. For example, the ghettos of black people were described as cities within cities in American society (Wacquant, 1998, Robinson, 2012). The concept of ghetto was first referred in 1516 to a Jewish community located inside but also walled off from the Venice city, which was a response from the senate of Venetian Public to the increasing population of Jewish refugees immigrating from Spain. During the world war II, in central and eastern Europe Nazi reset ghettos to enclose Jewish people within walled communities (Kreichauf, 2015, Dobroszycki, 1987). During the post-war period, though the physical enclosures and gates fell down, the concept of ghetto was inherited to describe the ethnic discrimination and socio-spatial segregation. The social inequalities led to high unemployment, crime, fewer chances, lack of education and poverty in ghettos (Jargowsky, 1997, Spear, 2018). The concepts of CICs as well as "dual cities " describing ghettos suggested a "vague and shapeless metaphor" for social inequality and division in modern western societies (Marcuse, 1989). Different form post-war ghettos in western societies by segregating immigrants or minorities from the city through invisible walls, the Chinese modern work units with visible walls were developed to industrialize China and to acquire an equalitarian urban life among the workers. In China, the enclosures walling off public visitors, the inside social consumption/production as well as the welfare systems guaranteed by work units experienced different space uses and transformations of modern CICs. Based on the comparison of CIC concepts between different regions with various social and economic contexts of the world, the unique features of typical CICs in mainland China have been distinguished in this dissertation.

1.2.2 How are CICs employed in Chinese urban planning both in agricultural and industrial societies? Examine the construction and transformation of CICs in functions and populations.

Before the industrialization of modern China, the dominant agricultural society had existed for thousands of years. However, except during the Qin and Han dynasties there were multi-CICs[3] within urban areas, Chinese CICs experienced an extremely slow transformation. The stable concentric style of city walls and the single imperial/palace CIC within a city constituted the common features of an ancient capital city. The construction of ancient CICs in China was heavily dependent on the state finance controlled by the ruling classes in form of taxes on peasants and products from the agriculture production. Though many old CICs were destroyed in wars and new ones were built, their functions were passed from one dynasty to the next with slow changes. In contrast to imperial/palace CIC, to protect the growing urban population, the construction of some larger scale outer city walls transformed the original walled outer city into an inner city (an atypical Chinese CIC) for regular citizens. In conclusion, depending on the changes of political and economic backgrounds, the scales, morphologies and functions of ancient CICs were adapted in accordance with social production level and the growth of the urban population.

In addition to ancient CICs, some pre-industrial towns, which did not function as CICs in ancient periods, became CICs due to the construction of modern urban areas after 1949. This phenomenon also cultivated for developing a tourism economy in the reform period since 1978. Though the pre-industrial towns preserved or even restored their heritage city walls, the single tourism function within these ancient towns indicated there was no collective life integrating job and housing based on highly mixed land uses.

In China, the typical modern CICs built by work units between 1949 and 1978 underwent a radical social transformation. The collective life based on the land use mix was rebuilt within modern CICs and the urban populations were transformed into the work unit

[3] In capital city Xian'yang, the emperor Ying Zheng of Qin built a dozen of scattered palace CICs which exacerbated the exhausting of national finance. Latter, the first emperor Liu Bang of Western Han built the capital city Chang'an with 7 palace cities on the remains of Qin palaces. When Western Han fell down and Eastern Han rose, there were only two palace cities within the capital city Luo'yang.

members. The collective production developed by work units contributed to the transformation process of China from an agriculture society into an industrial society since 1953. Even in Mao's great leap movement and ten years' cultural revolution, the construction, production and consumption inside university and enterprise CICs still function to some extent for stabilizing the social order. Furthermore, those modern CICs, as spatial products of a centrally planned economy, also experienced differentiation in the market reform. Some CICs developed while the others went bankrupt or were transformed into creative/innovative business parks for emerging industries. In contrast to the fall of ancient palace CICs in the wars, the deconstruction of modern CICs derived from the enterprise reform in the 1990s, which also accompanied the industrial transformation from secondary industries to service sectors as well as from low-end manufacturing to high-end manufacturing in urban areas.

China has been transformed from an agricultural society to a modern society as well as that from a centrally planned economy to a market based economy in China in the past 70 years. The socio-spatial institutions in China have changed rapidly, which has also led to new social/industrial production as well as a variety of approaches to urban space management during the construction and transformation of CICs. The urban lifestyles supported by Chinese CICs in different socio-spatial backgrounds from the past to present day have been examined in this dissertation. Based on a comparison between CICs transformed between different social periods, the space use characteristics of modern CICs have also been revealed and differentiated.

1.2.3 What are the obstacles modern CICs face in creating a permeable neighbourhood in Beijing? The hidden driving forces deterring modern CICs from removing the walls and gates will be examined.

Though gating systems function as the only spatial links between work unit CICs and the general public, the intimidating security guards always deter outside people from staying around for a long time (Qiao, 2004). However, according to previous studies (Xu and Yang, 2009, Gu et al., 2019), not all CICs maintain rigid gating systems even though most of them do have stable enclosures impermeable for the public. These modern CICs, as collectivist compounds for working and living produced in the socialist period, have also experienced a series of changes of spatial functions as well as the emergence of new industries. However, the impermeable enclosures and diversified gating systems constitutes the main impression of CICs for the outside public.

Additionally, there has been a wide discussion across the country about whether those stable enclosures and gates should be removed to create a more shared urban neighbourhood and to create a smoother flow of people for better socio-spatial integration. Since 2000s, modern CICs have been criticized for slowing the urbanization process (due to segregating the inner space from the public). Reducing urban diseases as well as promoting intensive land use have also been proposed as important topics which must be integrated into the top policy agendas (Wang et al., 2015). Furthermore, the government of China declares in new policy suggestions that the new gated communities would no longer be built and that the existent gated communities had to open their space to the public step by step (Xinhua News Agency, 2016). Nonetheless, a later official news release refuted an earlier report announcing the removal of the walls and gates of the campuses for Renmin University (RMU) of China and Beijing Institute of Technology (BIT) (Sun, 2016, Zhao and Sha, 2016). The government policies always face risks being critiqued due to the gap between the fuzziness of policy implementation and specific public demands (Zhao et al., 2009). The dilemma between creating a permeable urban environment and protecting the campus walls continues to be a contentious topic among the public.

Current social critiques and academic proposals are not sufficient to comprehend and resolve the difficulties exacerbated by modern CICs. More empirical analyses should be conducted to explain the preservation of the enclosure and gating systems of modern CICs pursued by both governments and CIC members. In particular, the driving forces behind the preservation of the walls must be revealed.

1.2.4 How do space use mechanisms of campus CICs support a high population density in megacity Beijing? Examine the predictions of the fall and rise of modern CICs in China.

Urbanization accompanied by industrial transformation and the growth of the population have deeply influenced modern CIC life in China. There are three types of modern CICs primarily built by enterprises, public institutions (education/research) as well as government agencies (Wu, 2013). Urban industrial reform has led to the transformation of most enterprise CICs into more open public environments for tertiary industries, innovative high-tech industries as well as communities for commercial services. In contrast, the development of many other modern CICs for education/research institutes and government agencies has remained stable since the market reforms after 1978. Furthermore, some CICs experienced both vertical and horizontal space expansions, which in turn absorbed the increasing population due to new industrial policies.

In the economic reform period starting from 1990s, private developers were encouraged to participate in housing projects and provide public services for the work units (Li, 2005b). In addition, Bray (2005) also referred to the "compound wall economics[4]" of university CICs as well as new private housing developments to support his prediction of the disappearance of work unit enclosures. This suggests that the deconstruction of modern CICs would lead to a more permeable environment.

In contrast, the rise of gated communities for commercial residence neighbourhoods in China has also been the object of social critiques due to the lack of a job-housing balance (Ta et al., 2017, Zhang and Zhao, 2017) and the spatial segregation from the general public (Deng, 2017, Breitung, 2012, Wu and Webber, 2004). Moreover, the conflicts between owners and developers (Deng, 2018, Huang, 2006) also reflects another space use issue: the contradiction between residents (service consumption) and developers (service provision). The owner-committees were created to reclaim their rights and interests from the developers, which also produced endless conflicts between each other. Enlightened by hold-up problem (Rogerson, 1992) in economy theories[5], whether the work unit system that can combine the identities of both parties in public services could

[4] Some of the walls of work units were transformed with service functions towards outside public, which enriched the public street life. However, these turn-outside "walls" were still impermeable enclosures between the modern CIC and public environments.

[5] In the hold-up problem (commitment problem) here, the service provider and service consumer belong to different parties in a contract and the latter one always "hold up" the former one because of the dissatisfaction about values the former one has committed. In gated communities, the house owners and developers cannot build an efficient cooperation because of mutual distrust between each other in understanding the flexible terms in the contract. In contrast, the house owners the developers in a work unit are colleagues with close relationship to each other, which imply a combination of party A and party B in the public service within modern CICs to revolve the hold-up problem.

revive in the future Chinese society was wondered by Deng (2018). Hence, the prediction of the rise of modern CICs in China should also be based on the resolution of hold-up problem between producers and consumers of public services in the economy reform.

To respond to above predictions first, further empirical studies have been included in this dissertation based on big data analysis as well as depth interviews. Then the key influence factors in the space use and transformation of CICs have been examined. Finally, an analysis combining production and population management will be promoted to consider the future outlook of CICs.

1.2.5 Can spaces within enterprise CICs deteriorating in the market reform readjust to the industrial transformation? Explore the transformation of space use in selected CICs.

In contrast to the slow transformation of CICs in agriculture society, the quick urban industrialization as well as the later urban industrial transition accelerated the developments/transformations of modern CICs. To some extent, the industrialization and social division of labour created the soil for the development of modern Chinese CICs between 1949 and 1978. However, the continued economic reform since 1978 "planted the seeds" for the transformation of enterprise CICs after 1992. During this process, the CICs constructed by state enterprises experienced spatial destruction, land transaction as well as spatial reutilization. The reduced competitiveness of state enterprises in the market eroded their capability to provide public welfare/services inside their CICs. Moreover, the increasing unemployment further deprived CIC members of stable incomes. Particularly for modern CICs in secondary industries, the collective life style combining production and consumption collapsed in the land transferred to commercial projects as well as the integration of emerging industries from private domains in a free market based economy. In Beijing, a few state enterprises preserved some of their industrial buildings and transformed them into workplaces for emerging industries. Although the individuals working in these enterprises are removed from the past collective life integrating production and consumption in CICs, the space use is still influenced by the work unit governance. In this context, some of the abandoned factories were transformed into the industrial parks for creative/innovative companies.

Simultaneously, the close ties between work unit colleagues were weakened due to the decline of enterprises, which further undermined the job-housing balance[6] developed in original modern CICs. This is due to the local residents needed to look for jobs in other places as well as many the emerging industries thriving here employed individuals living far away. In particular, the majority of individuals working there did not live there. Nevertheless, the commercialization of land use to construct new high-rise office buildings as well as transformation projects to preserve and reuse old industrial buildings contributed to the construction of a permeable urban environment.

Compared with stable CICs for universities and government agencies, the space use transformation of enterprise CICs symbolized the destruction of collective life within modern CICs in China. Benefiting from bottom-up and top-down oriented transformation paths of industrial heritage buildings, some enterprise CICs successfully became creative/innovative parks in the revitalization of urban environments. How were differing transformation paths integrated into the revival of CIC spaces? Is this type of transformation a prevalent phenomenon in the past of Beijing? Moreover, the evaluation of the transformed CIC spaces in adjusting to the social/industrial reforms has also been included in this dissertation.

1.3 Research gaps in the field

1.3.1 Methodology weak on the transformation of Chinese CICs from ancient society to modern society by integrating the empirical analysis of urban space use and social production

The heritage of the Forbidden City in Beijing has a history dating back to Yuan dynasty. However, the capital cities of two earlier states (Ji state in Zhou dynasty and Jurchen Jin during Song dynasty) in the same location also had palace cities within outer city walls. Wu (2005) described the Forbidden City as an "enlarged version of courtyard housing", which is also a "walled city". The author also wrote that the diversity combining collective job, housing as well as service inside the residence enclosure system in the Chinese tradition was impossible to find in the American study cases described by Chicago School.

[6] The concept of job-housing balance implies: "the attainment of jobs within a reasonable commute distance to homes (Wu et al. 2015). "

In addition, scholars appear to prefer to focus on the general urban enclosure and gating systems in China to reveal their social function in culture, political control and economic management (Bray, 2005, Huang, 2006, Wu, 2005, Tomba, 2010, Yao and Wei, 2012, Wu, 2013), rather than differentiate between courtyard houses, gated communities and diversified CICs to reveal their differences in space use. The common collectivist tradition as well as the awareness of family/lineage ties was deemed as a key factor in understanding the Chinese enclosed form of residence (Huang, 2006, Bray, 2005). While there are still CIC space use mechanisms for both consumption and production in China and a variety of forms of transformation in a rapidly changing social background in nowadays, these mechanisms require an epistemological continuum to distinguish the space use mechanisms of CICs from ancient society to present-day China. The land use mix combining urban life and employment within CICs has a far-reaching impact on the various transformations in modern China, which should also be differentiated, identified and recorded via an empirical analysis.

1.3.2 Scholars were fascinated by the destruction of modern CICs and their integration into the public, however comparatively neglected the vertical-horizontal expansion of university CICs and multi-levels' transformation inside enterprise CICs.

The economic transition/transformation of China (Morris et al., 2001, Wu, 2002a, Ma, 2002) exacerbated the decline of loss-making state enterprises, which subverted the job-housing balance developed in original spaces of enterprise CICs before 1978. Even though new policies in 1990s was created to reduce the burden of state enterprises through the socialization of workers' welfare (Jefferson and Rawski, 1994, Hay et al., 1994), many of the enterprises went bankrupt. The commercialization of land use further transformed many CICs into open service/office areas as well as gated housing communities. The enterprise reform, new housing policies, housing and income inequality, long distance commutes, unemployment and emerging gated communities, all of which contributed to the demolition of CICs built by state enterprise, attracted scholars' attention (Wu, 2002b, Womack, 1991, Lin and Bian, 1991, Wu, 2004a, Zhang, 2002, Zhao, 2002, Huang and Clark, 2002, Logan et al., 1999a, Wang and Chai, 2009, Bian, 1997, Bian and Logan, 1996). In addition, scholars also elaborated on the spatial transformation of enterprise work units which tended to be more open and permeable (Zhang and Chai, 2014, Zhang et al., 2009a, Yin et al., 2015, Currier, 2008).

Nonetheless, if the urban space use issues in market reform period are explored through studies of CIC, two more neglected topics should be mentioned. The first is the dual expansion of university CICs and the second is the multi-levels' transformation of enterprise CICs. In this dissertation, the former is associated with: 1. The burden of a greatly increased population density as well as the high vitality of space use inside CICs; 2. the special mechanisms of space use balance in campus CICs constituted by land use mix, spatial expansion and flexible interaction with outside public services; 3. distinctive space uses between campus CICs based on their specific socio-spatial division. In conclusion, the expansion of urban spaces and space uses inside campus CICs require further exploration. The second topic, multi-levels' transformations of surviving enterprise CIC spaces, will be explored with empirical case studies. This part includes three main features: 1. functional transformation influenced by respective location advantages to different urban industries; 2. the homogenous transformation sequence of different zones due to the limitation of financial support as well as the accessibility of surrounding transportation; 3. the choice between top-down and bottom-up oriented transformation paths.

1.3.3 The collectivist production and consumption within CIC enclosures for work unit members has been explored by scholars, but the current space use mechanism integrating the socio-spatial mix in modern CICs must be examined.

The collective working and living under the independent governance of work units is a key feature of modern CICs in China. Scholars have indicated that the work unit functions as basic urban cells for socio-spatial governance (Lu, 2006, Zhang, 2005, Bray, 2005, Wang and Zhou, 2017, Bray, 2006).. Previous empirical studies did not examine the development or transformation of job-housing balance and social mix in modern CICs as well as the examination of them in hourly based space use. For example, the social mix inside the selected universities in Beijing today still benefit from the fair policy on enrolment examination. From 1977, Deng Xiaoping cancelled the unfair recommended-selection system in the enrolment in higher education. After that, students from anywhere as well as in any social classes have the free choice to take the university entrance examination. This guarantees the integration of students from different social backgrounds, from both rural and urban areas of China, in campus CICs. In contrast, compared with the stable collectivist life inside the university, the new space users in transformed spaces of original enterprise CICs are mainly comprised of private companies and individuals with different social backgrounds. Though the latter situation destructed previous collectivist life produced in modern CICs before 1978, it created a new social mix inside the transformed industrial heritage areas after 1992. For example, though they came from different social backgrounds, the artists, designers, gallery managers, grocers, restaurant operators as well as the work unit managers all contributed to the transformation of CIC spaces of North China United Radio Appliance Factories into 798 Creative Park. However, there are not enough studies of the mechanisms for the development and transformation of socio-spatial mix in different types of modern CICs.

In this dissertation, the selected campus CICs and industrial transformation projects in Beijing have been studied through field work, in-depth interviews and big data analyses. The evaluation of the socio-spatial mix produced by planning in well-developed CICs as well as those formed spontaneously in deconstructed CICs will also help to reveal the specific space use/transformation mechanisms in CICs in Beijing today.

1.4 What perspectives and methods can be applied to examine the phenomenon of Chinese CICs？

1.4.1 From a genealogy analysis to a spatiotemporal analysis: the path of the CICs' construction/transformation of space-use across millennia

Bray (2005) applies Michel Foucault's genealogy theory[7] to analyse specific practices regarding work unit spaces constructed in China after 1949. The local particularities of the Chinese spatial tradition and social reform constituted a significant part of Bray's study. In Foucault's elaboration on genealogical analytics, "Genealogy works on the limits of what people think is possible, not only exposing those limits and confines but also

[7] The genealogy analysis derived from the philosophy of Friedrich Nietzsche (1844-1900). FOUCAULT, M. 1978. Nietzsche, genealogy, history. declared: "Nietzsche, however, reproached critical history for detaching us from every real source and for sacrificing the very movement of life to the exclusive concern for truth".

revealing the spaces of freedom people can yet experience and the changes that can still be made" (Crowley, 2009). Bray (2005) summarized the genealogy analytics from Foucault as four areas: "First, the interconnectedness of power and knowledge; Second, the importance of technologies of the body to modern power relations; Third, the importance of uncovering the operational principles, or rationalities, of government; Last but not the least, the necessity of incorporating the problem of space into broader modes of genealogical analysis." Based on above theories, Bray emphasized the importance of space as a media of production and indicated the scarcity of space analysis in understanding space uses in modern China. Moreover, scholars have explored the relationships between the lives within Chinese enclosures/gates and the culture, politics as well as economic practices in different periods of China (Huang, 2006, Wu, 2005, Yao and Wei, 2012, Bray, 2005). Incorporating archaeological findings on ancient cities and studies of modern cities in China, new details have been integrated into the analysis of the transformation of CICs from ancient periods to present day China in this dissertation.

To uncover the transformation of residence areas in a work unit called Beijing No.2 Textile Factory, scholars (Zhang et al., 2009c) studied spatial transformations from different periods. Based on the design archives and construction records from the housing management division, Zhang et all described the land use commercialization inside and on the border of work units as well as the transfer of service functions from inside to outside of the work units. Due to the lack of big-data analysis in early days, the empirical studies of work unit CICs cannot reveal the hourly real-time space use of CIC members. Moreover, the space use in original CIC production areas of Beijing No2. Textile Factory also has recently experienced changes, but there has been no spatiotemporal research on these changes. However, employing hourly big data analysis of modern urban life in China, this dissertation explores Chinese CICs to reveal the performance of socio-spatial production and consumption.

1.4.2 Field studies and in-depth interviews to examine the mechanisms of space use and transformation of modern CICs in China

Some scholars (Huang, 2004, Yao and Wei, 2012, Xu, 2009a, Zhang, 2004, Lu, 2006, Zhang and Chai, 2014, Zhang et al., 2009a) integrated field studies to uncover the details of space construction and utilization in work units. Photos they took in different periods also depict the life of work unit CICs. Moreover, Xu (2009a) noticed the existence of low accessibility and temporal management of work unit gates and their influence on the spatial perception and utilization by individuals inside and outside work unit CICs. In addition, Zhang and Chai (2014) found that work unit spaces were becoming more and more open because the number of gates being increased to promote the accessibility between inside and outside as well as the walls being shortened through the transformation of some boundary spaces into open landscapes. Hence, the various enclosure-gating systems of work unit CICs in present day should be further explored to confirm previous findings as well as to re-evaluate the current performance of these enclosures and gates.

On the other hand, to further reveal individuals' space use in work units, Lu (2006) interviewed the people working and living inside as well as outside work units. Lu's own experiences of campus CICs and her relative's experiences of working inside work unit but living right outside contributed to explaining the interaction between CICs and the public from a unique perspective. In another study on a CIC work unit, called Tongrentang Chinese Herbs Pharmaceutical Factory, Zhang and Chai (2014) conducted 60 trial-pilot interviews and a further 10 in-depth interviews and revealed the different transformation stages for gate removal and opening up the spatial form in Tongrentag. Moreover, they stated that, in addition to their particular case study, there are different spatial performances in different types of work units which require study, because of the significant influence of work units on urban life in modern China. In this dissertation, in-depth interviews with the planning experts, CIC residents as well as work unit managers have been conducted at different types of CICs. The viewpoints of individuals in campus CICs and enterprise CICs should help uncover the space use and transformation mechanisms of modern CICs in China.

1.4.3 The big data analysis of spatial features including space use vitality should contribute to understanding the present-day performance of CICs in China

The modern CICs can be evaluated through observing their space use vitality. Though Lynch (1984) included the vibrant functions as one of the key attributes to define urban vitality[8], the observation of urban vitality relied mainly on the experience of scholars in the field study. However, due to the boom of big data and the resulting urban analytics, different spatiotemporal granularities in human-oriented space use issues in China have been explored by scholars (Long and Liu, 2016, Long and Huang, 2019, Xia et al., 2020, He et al., 2018, Wu et al., 2018, Jin et al., 2017). In big data analytics, the land use vitality can be classified according to specific locations and functions, which further reveals where and how individuals utilize their urban environments. The combination of physical observation and big data analytics should increase the understanding of urban vitality issues in Chinese urbanization. On the other hand, the application of big data to analyse CICs also suggests new possibilities to reveal the space use and transformation mechanisms in different types of CICs in modern China. In addition, the elaboration and evaluation on space use and transformation in modern CICs would be more robust by integrating a big data analysis of the land use mix, enclosure-gating systems as well as real-time space use, and more.

1.5 Research outline

Chapters 2 and 3 review the existing theoretical backgrounds to develop the research hypotheses. In Chapter 2, the studies of CIC concepts in mainland China and other regions of the world are reviewed. In Chapter 3, the combination of high socio-spatial mixes and low spatial permeability in Chinese modern CICs are compared with other types of gated communities. In particular, urban vitality studies of Chinese cities are reviewed in this chapter. In addition, Chapter 4 introduces methods applied to explore the land use mix, enclosure-gating system as well as local experiences and demands, etc. Chapters 5 and 6 present the main research findings. The lineage of CICs in China from the ancient period to modern time after 1949 is explored in chapter 5. In particular, Chapter 5 mainly explores the structures and functions of the ancient CICs. In contrast, chapter 6 mainly focuses on the construction of work unit CICs after 1949 as well as the transformation of CICs after 1978. Different types of CICs in China have been classified and studied (Figure 1.1). However, the typical CICs including the palace cities and work

[8] Jin, et al. (2017) wrote: "Kevin Lynch believes that the primary criterion in the quality assessment of urban space form is the vitality, which is defined as a settlement (the dimension urban morphology) that supports the vital functions (the dimension urban function) and the biological requirements and capabilities of human beings (the dimension urban society), and how to protect the continuation of the species (Lynch 1984)".

unit communities are the main focus of this dissertation. Chapter 7 contains the discussion and conclusion.

Published Peer Reviewed Article: Gu, Yan, et al. "Exploring the space use mechanism of high-density campus in urban Beijing." Habitat International 91 (2019): 102024.

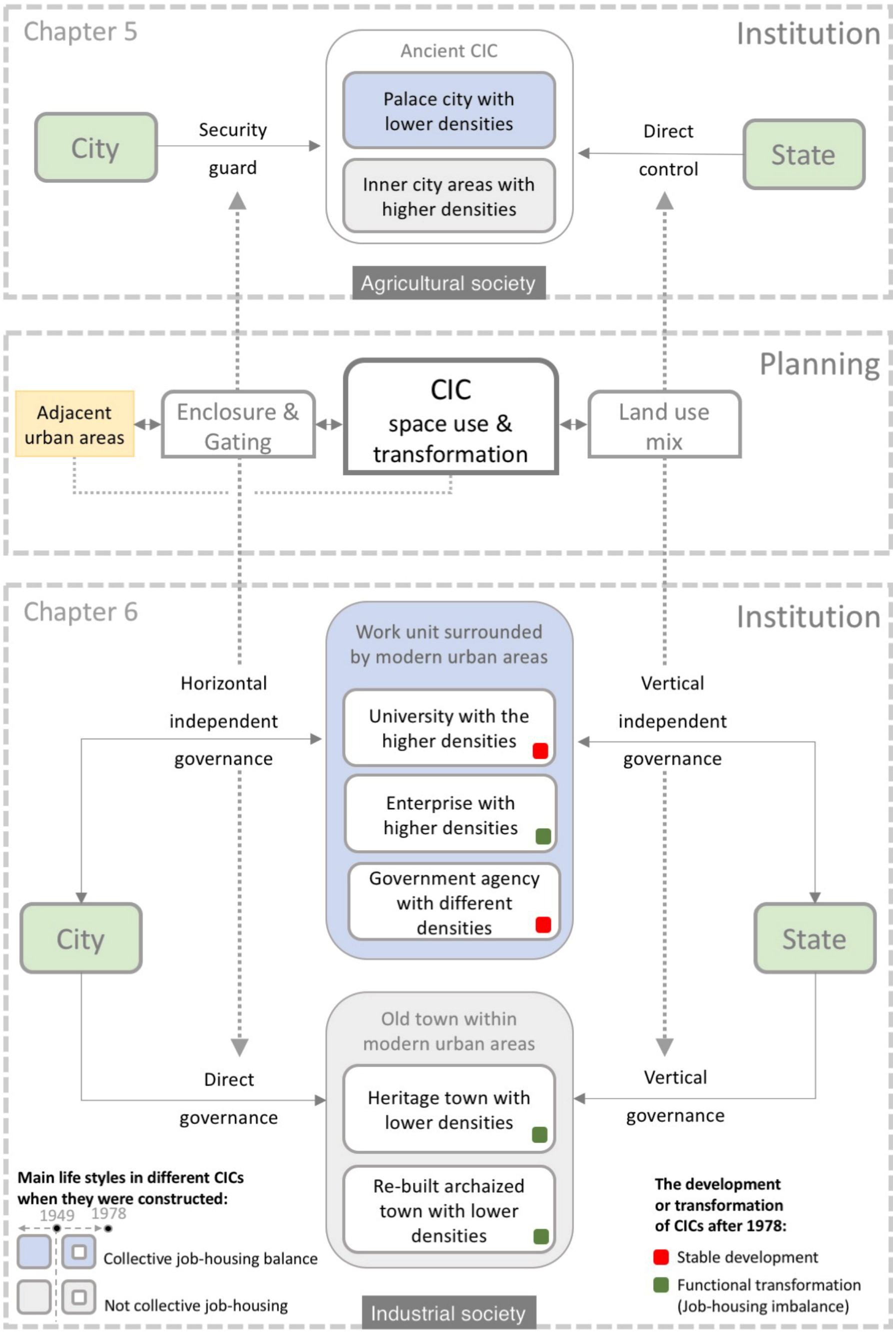


Figure 1.1. The research outline for selected case studies as well as their classification and social-spatial management structures in this dissertation.

Chapter II

COLLECTIVE WORKING AND LIVING INSIDE CICS:

A FEATURE TO IDENTIFY TYPICAL CHINESE CICS

2 Collective working and living inside CICs: a feature to identify typical Chinese CICs

2.1 A CIC or not: the existence of small inner city in Chinese Neolithic archaeological remains

2.1.1 The small inner city and the large outer city were both enclosed by rammed-earth walls: the archaeological evidence of CICs in pre-historical remains?

Several archaeological remains dating back to Longshan Culture period (2500-2000 B.C.) have been found around the middle and lower reaches of Yellow river (Nu, 2006, Brunson et al., 2016, Underhill, 1994, Liu, 2005). Based on the archaeological findings to classify different areas, such as the palace area, the upper class residences, lower class residences, handicraft area, burial area and religious sacrifice area, Gao (2007) declared that the spatial differentiation in Tao'si (2300-1900 B.C.) also revealed a strict social stratification. In addition, an outer large city (dating from the middle period of Tao'si) had a small inner city (east-west length: 470m; north-south length: 270m) where archaeologists found large-scale buildings for astrology and religious activities. However, the lack of remains of walls completely surrounding the small inner city makes it difficult to prove the existence of a mature palace city within Tao'si (Pang and Gao, 2009, Gao, 2007, Gao, 2013).

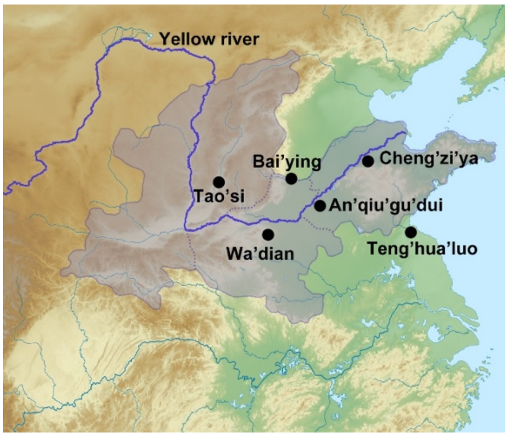


Figure 2.1. Some of the archaeological remains in Longshan Culture period. Figure drawn by the author.

The appearance of Teng'hua'luo remains as well as other case studies existing during the same era seems to cover an earlier pre-historical CIC life. Teng'hua'luo was inhabited by human beings between 7000 and 4000 years ago (Nanjing Museum, 2014). The remains of inner-city wall and outer-city wall coexist in current Teng'hua'luo (Xu, 2017b). Zhang

(2003) also believed that the existence of Teng ‘hua’ luo suggested the new origin possibilities of the city structure depicted in the King City Map of Zhou dynasty. The different versions of the King City Map are in close proximity with a king palace city located in the centre of the larger outer city. In Teng'hua'luo, the small inner city (10,000 m^2) and the outer city (140,000 m^2) contain residence areas and there is no clear social stratification between the inner city and the outer city. However, there are still some disputes about the existence of the CIC structure in the remains of Teng'hua'luo. In the remains of Tao'si, a later constructed ancient city in Longshan Culture period, the social stratification could be demonstrated by the differentiation between upper social classes living within palace area and lower social classes living in the large outer city. However, there are no complete wall ruins between the inner and outer cities to prove the existence of a palace CIC in Tao'si. In contrast, Teng'hua'luo remains are at a smaller scale compared with Tao'si. Why could Teng'hua'luo develop the CIC structure without using it to segregate different social classes? Exploring this question in this research will contribute to revealing the structural formation of the earliest CICs from pre-historical era to Three Dynasties.

2.1.2 An argument about the morphological precedents of walled palace CICs existing before Three Dynasties

With regard to the space use of Teng'hua'luo, Wang (2017) argued that the construction and usage of the small inner city was earlier than that of the large outer city. With the building of the outer-city wall completed, citizens started to remove the inner-city wall. All the inferences by the author are based on an archaeological dating analysis. The difference in space use periods of inner city and outer city might contribute to uncover why there were no clear social stratification between the inner city and outer city in Teng'hua'luo. Liang et al. (2015) and Liang and Jia (2017) studied the remains of Yao'wang city in Rizhao of Shandong province, and found a similar construction process for the small city and large city to that in Teng'hua'luo. Cheng (2009) also argued that in the city Wang'cheng'gang, another important archaeological site dating from Longshan Culture, the small city and large city were built and used in different periods. Based on the above research cases and findings, we can summarize their common attributes. First, in the archaeological remains of these prehistorical cities from Longshan Culture the small city was located within a large city. Second, the small cities were built earlier than their outer cities. Finally, the small inner cities in these case studies are not real CICs (king palace city) within the larger outer cities due to the highly-mixed residences in both inner and outer cities. Except the incompletely walled palace CIC existing in Tao'si, there were not many typical CICs in pre-historical China. Since the small inner city and large outer city in Teng'hua'luo harboured residents without apparent social stratification due to segregation by city walls, the construction of the outer city must have had a different motivation which require further research to determine the formation of CICs mainly existing as archaeological remains.

2.2 The ancient CICs integrating state governance and royal life based on collectivist political control and economic production

2.2.1 The ancient CIC structure can be summarized from studies of urban features in ancient China

In Three Dynasties (Xia, Shang and Zhou), the earliest recorded wide-region kingship states in Chinese history (Xu, 2017), the CIC phenomenon can be easily found in archaeological remains. The first typical CIC found in Er' li' tou was considered the palace city (Hong, 2004, Er'li'tou Archaeological Team of Institute of Archaeology in CASS, 2005) in the capital city of Xia dynasty, which some also argue is the same as Shang dynasty (Allan, 1984, Thorp, 1991).

Despite the lack of studies focusing on the concept of CIC, we can still base the study of ancient CICs on past research findings about Chinese urban planning and architecture history. In particular, with the increasing number of archaeological discoveries about ancient city remains and the depiction related to CIC in the pre-1949 literatures as well as art works, the exploration of ancient Chinese CICs will also benefit from historical resources. With the classification of CICs into palace city, imperial city and inner city within walls and gates, a review of records and descriptions in Chinese history can reveal the continuity of CICs in China. Yan (1987) introduced 17 ancient capital cities without time sequence. Lei et al.(1995) introduced the huge number of Chinese palaces. Some scholars (He, 1996, Dong, 1988, Wang, 2005, Steinhardt, 1999, Zhang, 2009b, Xu, 2004) focus on the study of urban planning and construction in those ancient cities. There are also some architectural historians trying to reveal the ancient city structures in China (Liu, 2009, Fu, 2001). In the above studies, the palace cities, royal cities and inner cities in different dynasties were introduced. From the historical records and archaeological findings, the early enclosed palace CICs functioned mainly as palaces of the ruling classes. The walls surrounding palace cities segregated the normal citizens from the royalty. The inner cities which later appeared surrounding palace cities served the normal citizens due to the population growth as well as the construction of larger outer city areas outside the walls of inner cities. Moreover, the objective of the spatial division (between different city zones) represented by walls and gates was consistent with the social stratification trend and demands of protecting the increased amount of citizens.

In an angle of city planning comparison spanning decades or even dynasties, some studies of ancient city planning provide fruitful resources for the study of ancient Chinese CICs. Some scholars focus on the changes of a specific capital city in a specific dynasty (Tang and Du, 2008, Liu, 2004, Wu et al., 2008). Some scholars focus more on the changes in a specific city in adjacent dynasties (Li, 2007, Niu, 2015). Moreover, some scholars are fascinated by mutual influences of several cities spanning different dynasties (The Institute of Archaeology Chinese Academy of Social Sciences, 2002, Qian, 2016, Steinhardt, 1986, Steinhardt, 1999). However, the above studies did not reveal the construction / transformation lineages for Chinese ancient CICs from prehistorical period to the last empire in Qing dynasty.

2.2.2 CICs combining state governance and royal life within walls assisted in city planning and population management of ancient capital cities

The first ancient walled CIC was the political centre of the earliest recorded states in Chinese history. In the study of Er'li'tou, Xu (2018) declared that these ancient remains were the first non-fortified (without outer city wall) capital city in Three Dynasties of China. Xu based his conclusions on the assumption of a strong central government in Er'li'tou as well as the lack of military threats. Rather than focusing on the CIC phenomenon, Xu (2017a, 2000) focuses on the lack of outer city walls . However, the existence of the palace city in Er'li'tou confirms the appearance of the earliest walled CIC in ancient China. Moreover, whether there were outer city walls or not, the existence of palace city walls was prevalent in the recorded history of Three Dynasties. The palace cities, which also integrated the functions of normal royal life, ruling affairs and even the religious activities etc. within the fortified CIC enclosures, were clearly designed to protect the royalty. The social stratification was revealed in the archaeological remains in form of spatial segregation, which divided upper and lower social classes. Zhao (2006a) studied the urbanization in ancient times by combining analyses of demographic factors and urban functional development, which also provided a macro perspective on the regional resource exchange that supported the development of capital cities.

In addition to studies on urban functions, the population management in ancient cities also attracted scholars' attention. On the urban demographics in pre-Qin period, though there is a lack of ancient census data and ancient records, scholars (Jiang, 2002, Song, 1994b, Lin, 1986) have estimated the city population during that period through the low floor area ratio (FAR) and the average number of persons per household based on the analysis of archaeological remains and ancient Chinese literatures. Jiang (2002) and Xu (2017a) also pointed out that a huge change took place in Warring States period, during which the palaces in capital cities became larger than before. Moreover, Jiang (2002) declared that the population density inside the palace city was smaller than that of the outside residence areas in the city. Though the population of servants and guards inside the palace city was not inferred, the author claimed that the per capita living area inside the palace city was larger than the general residence area outside the palace. There are more explorations of population densities in ancient CICs and surrounding urban areas with increasingly detailed information after Han dynasty (Han, 1996, Zhao, 1994, Li, 2005a, Wang, 1999a), likely because the urban population management was differentiated for the palace city, inner city, as well as other residence spaces for the normal citizens.

From the studies of capital cities Chang'an and Luo'yang in Han and Tang dynasties, the construction of imperial cities and palace cities appear to have been given an absolute priority in construction planning and expenditures (Dong, 2018, Zhou, 2001, Qian, 2016). The tradition of locating palace cities in the centre or on the central axis of capital cities begun in Western Zhou dynasty and begun again after Western Han dynasty (Steinhardt, 1999), which also suggests the geographical superiority of CICs in the capital city. In contrast, the rising empire Qin between Western Zhou and Western Han abandoned the urban structure with signal central palace and constructed scattered large palace cities within the un-walled capital city Xian'yang and walled capital city Chang'an. Scholars explored the influences of cultural, political and economic mechanisms on city planning and population management based on records in chorography and archaeological discoveries (Xie, 2013, Xue, 2010). The Chinese collectivist tradition derived from the clan system was fortified in different social classes in ancient China. Confucian thoughts infused concepts of strong social ties based on family/lineage relationships in daily etiquette of ancient people (Bond and Hwang, 2008, Nisbett, 2003), so the various practices of collectivism in rural and urban space use are also embedded in different social structures for consumption and production. In particular, the remote geographical locations as well as a higher risk for parasitic disease in rural areas promoted collectivism among local people (Freeman, 1997, Schaller and Murray, 2011, Fincher and Thornhill, 2012). Moreover, Van de Vliert et al. (2013) stressed that the climatic demands and economic resources were imprinted on ancient collectivism. The above theories also mean the diversified collectivisms accompanied the social stratification and spatial segregation, which may contribute to accounting for space use and population management in ancient CICs. For any palace CIC, the collective life combining state governance supported by national finance has to be distinguished from the Li Fang[9], Hutong or court yard houses for normal citizens, where the collective lives of family members in each household were mainly referred to independent residence functions within enclosures and gates of yards. Within each court yard house, the members of every family live together and share a collective life. However, many of the public services and jobs were independent to the collective lives within court yard houses, which suggested a different urban lifestyle for normal citizens in contrast to palace CICs.

[9] Li Fang *里坊*: a type of ancient gated urban block unit surrounded by walls and gates. Within it, inner cross roads divided the court yard houses/buildings into residences and commercial services. The structure of Lv Li *闾里* (the predecessor of Li Fang *里坊*) was applied in the urban space management system of capital city Ye'cheng *邺城* in Cao Wei *曹魏* (the strongest kingdom in Three Kingdoms period) and became matured as Li Fang in capital city Chang'an of Tang dynasty (See chapter 5). The court yard houses within each Li Fang were isolated with each other by walls and gates. The public services within each Li Fang were shared by citizens form different Li Fang during day time. To some extent, there was no collective production and consumption for all citizens within a Li Fang. The social interaction and resource exchange between different Li Fang as well as between Li Fang and the markets constituted the main urban life style.

2.2.3 The influence of agriculture production and political control systems with a collectivist tradition on the construction of ancient CICs

In pre-industrial China, each social class had its own collective life which was integrated in different urban spatial enclosures. Huang (2006) wrote that the collective culture in history contributed to the widespread gating phenomenon in ancient settlements. Xu and Yang (2009) also referred to the culture of collective living with territory control and the housing compounds enclosed by buildings, walls and gates as two prominent features of China's traditional gated neighbourhoods. The collectivist clan system in pre-Qin society played a central role in organizing social life, which was also deeply rooted in the ancient agricultural production. The close social relationship between relatives in rural society also formed the basis for the collective production and consumption. In ancient times, agriculture production was a fundamental support for stabilizing the state finance (Deng, 2002), which was highly valued by different social classes. When looking back at the urban planning model in ancient cities, the land practice for agriculture cultivation made a deep imprint on the establishment of earliest CICs. The farmland system called Jing Tian system *井田制* classified the land orthogonally into 9 equal parts and divided land ownership between the government and peasants (Figure 2.2). Each household of farmers were assigned one of the 8 pieces of land around the centre of one piece of land and the production on the surrounding 8 pieces of land would belong to each household. The centre piece of land had to be cultivated by the surrounding farmers and the production on this piece of land had to be submitted to the government as an annual tax. This agriculture system, mainly in place before Warring States period, encouraged collective production within each peasant family as well as between families. The efficiency of production was also dependent on the collective cooperation between clan members in a village. Moreover, Jing Tian system influenced the city planning system as revealed on the King City Map to illustrate the capital cities in Western Zhou dynasty (see Figure 5.6 and 5.7). Though the system of Jing Tian was weakened and transformed into the other farm land systems, the collectivist culture formed in the clan system was preserved and integrated into the political systems in the following dynasties.

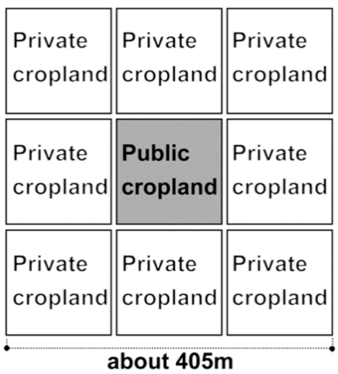


Figure 2.2. Jing Tian system applied in the agriculture production of Western Zhou dynasty. Figure adapted by the author from (Dong, 1988).

Due to the importance of agricultural production to the economy of ancient China, the political control tactics from central governance to local organization were an attempt to guarantee the income of state finance from taxation of the peasants, which constituted the basis for establishing CICs in capital cities. Moreover, a review of the economic and political management policies and targets in different dynasties will help reveal the impetus for the continuity/transformation of ancient CICs in China. Governance of ancient China was realized by both a macro bureaucratic system to control the state territory and a micro system for collectivist grassroots organization to maintain the local stability and agriculture production. The macro system was a multi-layer administrative structure from the central, provincial (Sheng), prefecture (Jun) and county (Xian) levels (Chung and Lam, 2009, Chien, 2009). In most dynasties before Three Kingdoms period, a two-tier governance structure was more common. In contrast, from Three kingdoms to Song dynasty, a three-tier governance structure became dominant in ancient China (see Figure 2.3). During Yuan, Ming and Qing dynasties, four-tier structure became common bureaucracy governance form (See "state political control" in Table 2.1).

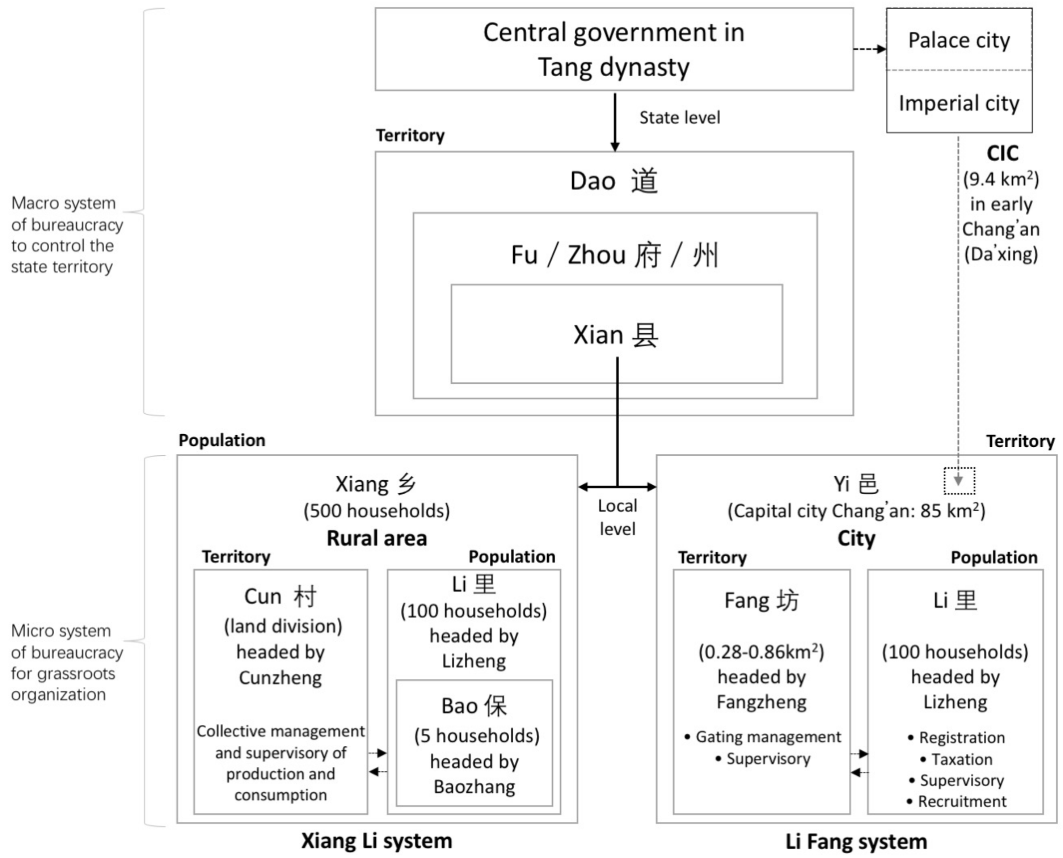


Figure 2.3. The state governance in Tang dynasty. On the national level, the state governance had a three-tier division based on different area scales of territories. At the local level, rural and city areas had their own management systems. Figure drawn by author based on (Wang, 1999a, Wan, 2013, Qi, 2003, Zhang, 2009a).

The local governance system further integrated collectivist mechanisms into political control and economic production. Zhang and Deng (2003) argue that the ruling class in Western Zhou dynasty employed the Jing Tian system as well as mutual aid between farmers. In Eastern Zhou, to organize local collective life, Guan Zi 管子 (719-649 B.C.)

implemented the Shi Wu system *什伍* during his reform of state Qi *齐国*. To stabilize local collective governance and reduce the cost of central governance, each Shi (consisting of 10 families) and each Wu (consisting of 5 families) had a manager who was responsible for the collective life and production, (Guan et al., 2015). Moreover, in the law of state Qin *秦国* established by Shang Yang *商鞅* (395-338 B.C.), to guarantee regular agricultural production and social order, the collectivist management based on harsh joint liability was established in the law system called Lian Zuo *连坐* (Ren, 1997), which tied the farmers firmly to the land. The free large-scale immigration of peasants was thereby forbidden by the central government. In state Qin during Warring States period, a registration system for each local household known as Bian Hu Qi Min *编户齐民* policy was implemented. Moreover, accompanying this registration system was a harsh collective joint lability, embedded in the law system called Shi Wu Lian Zuo[10] *什伍连坐*, which encouraged households to monitor each other. To some extent, the above policies strengthened central government control over the local people, which undermined the original community collective aid based on trust and even destroyed the close ties between family members. As a result of the potential mutual distrust among people at the bottom as well as their obedience displayed in agricultural production and war mobilization, local authorities could not organize powerful forces against the totalitarian rule of the king or emperor. This distortion of collective life led to the establishment of totalitarian governance in the Qin dynasty, which also led to the dying off of the tradition, before Eastern Zhou dynasty, of constructing CICs, which is examined in chapter 5.

The collective consumption and production were guaranteed by the political control system from the centralized governance within palace CICs to the local organization in rural communities. To some extent, the Bao Jia system established in Song dynasty was the continuation/transformation of Shi Wu Lian Zuo system in following dynasties after Qin (See "state political control" in Table 2.1 and Figure 2.3). Even in Republic of China between 1911 and 1949, the Kuomintang (KMT) government also implemented Bao Jia system in social management (Wang, 2003b, Gong, 2007). In addition, scholars agreed that the Bao Jia system[11], developed since Song dynasty, influenced the local urban governance of collective production and consumption in work unit CICs (Huang, 2006, Lu, 2006, Wu, 2011, Matthews, 1989, Lau, 2001).

---

[10] The Bian Hu Qi Min and Shi Wu Lian Zuo systems were employed during Shang Yang reform (356-346 B.C.). Shi Wu Lian Zuo system was developed base on the experience of Guan Zi's social reform in state Qi. In the same Shi Wu, if the families did not report any other family's crime when they knew of it, they would be killed, which reflected the harsh punishment of collective members due to joint liability in the law of Lian Zuo. Simultaneously, any family in Shi Wu had the responsibility to monitor the other families. If any member of a Shi Wu escaped from labour, all the other members would also be punished. In Bian Hu Qi Min system to register the population, the central government firmly controlled the labour resources through Shi Wu Lian Zuo system, which contributed to promoting the power of state Qin in Warring States period.

[11] In Bao Jia system *保甲制* designated by Wang Anshi *王安石* (1021-1086 A.D.) in Song dynasty, every Bao *保* had ten households and a manager (Baozhang *保长*). Five Bao constituted a Dabao *大保* which was headed by a manager (Dabaozhang 大保张). Ten Dabao constitute a Dubao *都保* which had a manager (Dubaozhang *都保张*). Every manager was selected from the richest people in each Bao, Dabao and Dubao.

Dynasty	Land distribution & tax system in agriculture	Technology	State political control （Rural / City）	Capital city planning
Three Dynasties (Xia, Shang, Zhou)	Jing Tian (a) 井田制 周公旦	•Bronze-casting	Patriarchal clan system 宗法制 Feoff system ＊＊ 分封制	**King City Map** • Central palace city • Outer city
Eastern Zhou **(Spring and Autumn)**	Imposed taxes based on land quality (b) The state of Qi. 管仲改革 相地衰而征 Chu Mu Tax. The state of Lu. (b) 初亩税	• Iron metallurgy • Cattle-drafted ferrous plough	[•] Shi Wu system The state of Qi 什伍制 管仲	**Flexible City Planning** • Palace city / Outer city • Outer city / Large city
Late Eastern Zhou **(Warring States)**	Imposed taxes based on the size of parcels of land (b) The state of Zheng. 子产改革 为田洫 Refined land exploitation (b) The state of Wei. 李悝改革 "尽地利"	• Progress in water irrigation	[•] Shi Wu Lian Zuo system The state of Qin 什伍连坐 商鞅 [] Bian Hu Qi Min The state of Qin 编户齐民 商鞅	**Flexible City Planning** • Palace city / Outer city • Small city / Large city
Qin	Ming Tian (b) From the state of Qin to Qin dynasty 名田制 商鞅变法 Kai Qian Mo (b) 开阡陌 Shou Tian (a) 授田制	• Development of intensive farming technology in northern dry fields	System of prefectures and counties ＊＊郡县制 [•] Lv Li system (city) 闾里制 [•] Xiang Ting system (rural) 乡亭制 [•] Shi Wu Lian Zuo system 什伍连坐 [] Bian Hu Qi Min 编户齐民	**City Planning with Multi-CICs** • Scattered Palace cities • Outer city
Han	Shou Tian (b) Western Han 授田制 Tun Tian (a) Western Han 屯田制 Xian Tian (a) Western Han 限田制		Jun Guo system ＊＊/＊＊＊ 郡国并行制 [•] Lv Li system (city) 闾里制 [•] Xiang Ting system (rural) 乡亭制（乡-亭-里） [] Bian Hu Qi Min 编户齐民	**City Planning with Multi-CICs** • Compact Palace cities • Outer city
Three Kingdoms	Tun Tian (a) The state of Cao Wei 屯田制 曹魏 Hu Diao 户调制		Zhou Jun Xian system ＊＊＊"州郡县"三级制 [•] Lv Li system (city) 闾里制 [•] Xiang Li system (rual) 乡里制（乡-里）	**King City Map** • Inner palace city • Outer city
Western Jin	Zhan Tian 占田制 Ke Tian 课田制 Hu Diao 户调制		Zhou Jun Xian system ＊＊＊"州郡县"三级制 [•] Lv Li system (city) 闾里制 [•] Xiang Li system (rural) 乡里制	**King City Map** • Inner palace city • Outer city
Northern Wei	Jun Tian 均田制 孝文帝改革 Zu Diao system 租调制		Zhou Jun Xian system ＊＊＊"州郡县"三级制 [•] Zongzhu Duhu system 宗主督护制 (early) [•] Li Fang system (city)	**King City Map** • Central palace city • Inner city • Outer city

			里坊制 [•] San Zhang system (rural) 三长制（党-里-邻)	
Sui and Tang	Bing Fu (a) from Western Wei to Early Tang 兵府制 Zu Yong Diao (a) 租庸调制 Mu Bing (b) 募兵制	• Technical system of intensive cultivation in southern paddy fields.	Dao Zhou Xian system ＊＊＊"道州县"三级制 [•] Li Fang system (city) 里坊制 [•] Xiang Li system (rural) 乡里制（乡-里-保)	**King City Map** • Inner palace city & Imperial city • Outer city
Song	Bu Li Tianzhi & Bu Yi Jianbing (a) 不立田制 ＆ 不抑兼并		Lu Zhou Xian system ＊＊＊"路州县"三级制 [•] Xiang Fang system (city) 厢坊制 [] Fang Guo Hu 坊郭户 [•] Bao Jia system (rural) 保甲制 [] Xiang Cun Hu 乡村户	**King City Map** • Central palace city • Inner city • Outer city
Yuan	Tun Tian (a), Guan Tian (b), Siguan Tian (a), Min Tian (a). 屯田，官田，寺观田，民田.		Xing Sheng system 行省制 ＊＊＊＊行省/路/州(府)/县 [•] Li Jia system (city) 里甲制 [•] Cun She system (rural) 村社制 [] Zhu Se Hu Ji system 诸色户计制度	**King City Map** • Inner palace city & Imperial city • Outer city
Ming	Tun Tian (b), Guan Tian (b), Zhuang Tian (a), 屯田，官田，庄田 Min Tian (a), 民田 Yu Lin Ce 鱼鳞册	• Popularization of multiple cropping and refinement of farming techniques	San Si system 三司制 ＊＊＊ 省/府/县三级制 [•] Xiang Fang system (city) 厢坊制 [•] Li Jia system (rural) 里甲制 [] Huang Ce 黄册 (Jun, Min, Jiang 军,民,匠)	**King City Map** • Inner palace city & Imperial city • Inner city • Outer city
Qing	Tun Tian (b), Zhuang Tian (a) 屯田，庄田 Min Tian (a), 民田		Xing Sheng system 行省制 ＊(＊)＊＊省/(道)/府/县三(四)级 [•] Xiang Fang system (city) 厢坊制 [•] Bao Jia system (rural) 保甲制	**King City Map** • Inner palace city & Imperial city • Inner city • Outer city
Notes	a. Reform towards private land ownership b. Reform towards state land ownership		Administrative system at national level ＊＊ Two-tier governance system ＊＊＊ Three-tier governance system ＊＊＊＊ Four-tier governance system [•] Local political control system [] Local household registration system	

Table 2.1. The classification and sequence of policies for political control and agricultural production as well as for CIC structures in ancient China. Table drawn by the author based on (Yan, 2007, Wen, 1935, Hu, 1993, Wu, 2003, Allen and Richards, 1999, Rodzinski, 1988, Marchant, 1981, Wu, 2004b, Smith and Von Glahn, 2003, Ebrey, 2010, Ren, 1997, Wang, 2007, Chen, 1991) .

2.3 The modern CIC concept differs from CIC concepts in other social environments outside mainland China

2.3.1 Modern CICs in China: from the rise of work units after 1949 to their development and transformation in the economy reform

With the fall of Qing dynasty (in 1912) the empire history ended in China, which also ended the creation of pre-industrial Chinese CICs in the coming social reform. Though in the short era of the Republic of China before 1949 the collectivist tradition continued in rural and urban areas, no CICs were constructed. After the founding of People's Republic of China in 1949, to establish the industrial production system to recover in the post-war era, the Chinese central government exploited the collectivist tradition to quickly organize the labour forces in rural and urban areas to promote agricultural and industrial production (Bray, 2005, Lu and Perry, 1997).

Modern CICs were constructed by work units (Danwei 单位) of public institutes, enterprises and government agencies after 1949. Zhang and Chai (2014) noted that the work unit communities in China were an export from the Soviet Union. Even though the concepts of short distance between residence and production areas, residence plots with basic service functions as well as land use zoning among old town, enterprise and housing projects were acknowledged by scholars, no significant studies introduce that job and housing were integrated within an enclosure-gating system (as China did) for most of urban work units in USSR or CEE countries (Bogdanov, 1923, Bliznakov, 1993, Sailer-Fliege, 1999). Moreover, the founders of China put more importance on industrializing China pragmatically (Pantsov and Levine, 2013), which determined the combination of modern industrialization and Chinese collectivist tradition in the construction of CICs for work units. To some extent, the Bao Jia system established in Song dynasty was transformed in modern work units to manage the collective working and living for workers (Huang, 2006). On the other hand, the design concepts of central axis plan as well as zoning plan for governance/production, residence as well as service areas in palace cities influenced the construction of modern work units to some extent. In addition, the pursuit of egalitarianism among increasing numbers of workers, as well as the promotion of urban industrial production, with support from agricultural production, contributed to urbanization by constructing work unit CICs as basic urban cells between 1949 and 1978. For the first time, a huge amount of large-scale work units constructed their own CICs, which integrated the production and consumption by normal citizens to create a collective system with job-housing balance within enclosures and gates.

2.3.2 Other CICs in modern China: the preservation and reconstruction of old towns within the modern urban areas

After 1949, many Chinese cities destroyed ancient city buildings, walls and gates to construct new buildings with high FAR and promote connectivity of public transportation. For example, Beijing removed most ancient city walls and gates between 1952 and 1958 (Kong, 2014). The current second ring road in Beijing is built along the site of the original ancient north inner and south outer city walls. In another case study, Chiang and Deng (2017) studied the sustainable transformation methods for heritage gating systems in the ancient city Gungnae, which has been surrounded by the modern urban areas. In contrast, the city walls of some ancient cities including Xian (Hall and Zhang, 1988), Nanjing (Yuan et al., 2016), and Pingyao (Wang, 2008, Su, 2018, Wang, 2012) have been preserved through heritage projects. Datong repaired its ancient city walls which were in an extremely poor condition. However, the above ancient cities did not have CIC structures before 1949. Because of the rapid urbanization in China, they become ancient cities within modern urban areas. Since they have been preserved as cultural heritages and to promote tourism, these ancient cities are not typical modern CICs in China.

2.3.3 The CIC concepts in modern western societies and other regions of the world

• CIC concepts in urban population management: the segregation and stratification of races or classes

Wacquant (1998) describes the dark ghetto in the USA as the "black city within the white" to. Robinson (2012) refers to the city in city concept to introduce his study on the "long civil rights movement" and "black freedom studies" in Michigan. Borsdorf et al. (2007) studied the fenced city outside the edge of urbanized areas in cities of Chile to reveal the problems ranging from polarization to fragmentation of metropolitan spaces. Goldstein (2013) examined the social isolation, disorder and privation issues led by the top-down oriented political and economic control in Harlem neighborhood of New York city to suggest the positive role of locally organized management in social development. On the other hand, Alsford (2019) uses the CIC concept to describe the universal aspirations and powers of urban elite to shape the urban landscape. The above studies mainly focus on social segregation of different races and classes in USA, which is distinct from the space within Chinese CICs with a highly-mixed population. Moreover, in this dissertation, the population densities and land use mix in modern CICs in China are also different from that in American "CICs".

• CIC concepts in urban space construction: urban campus, urban neighbourhoods and other urban development projects.

In the study by Bamakhrama (2015), different types of sub-cities or satellite cities in Gulf States were called cities in the city as an urban growth strategy. However, it is not clear how the space in these cities is utilized by the local population, under what population density, and in what specific hours, days and seasons. Aleksandra and Milena (2012) describe every one of the 25 neighbourhoods dividing the city area of Novi Sad, Serbia as an independent "city within a city". The authors primarily discuss how the multi-functionality and heterogeneity of urban areas increased the quality for those neighbourhoods. Duarte (2013) studied a Brazilian university city that is also called a city within the city, which is surrounded by urban avenues but not walls. Iveson (2013) mentioned the word "city within the city " as a metaphor for local bottom-up oriented urbanism, which encourage people's to take action to create a healthy relationship between the private and public realm. Iveson (2013) also employs the concept of "cities within the city" to show how to enact an individual's right to the city in the exploration of 'do it your-self urbanism'. However, the lack of information about their urban morphologies makes the exploration of the above CICs and their space use issues distinct from those in this dissertation. In particular, the above authors also have not revealed the dynamic urban space use by people in their case studies based on real-time collected data, which is what will be done in this dissertation for modern CICs in China.

Chapter III

THE HIGH SOCIO-SPATIAL MIX AND LOW SPATIAL PERMEABILITY IN CHINESE MODERN CICS ARE INCOMPATIBLE IN OTHER URBAN ENVIRONMENTS AS WELL AS WITH WESTERN URBAN THEORIES

3 The high socio-spatial mix and low spatial permeability in Chinese modern CICs are incompatible in other urban environments as well as with western urban theories

3.1 The concept of "social condenser" from Soviet society: an influence and its limitation to the construction of Chinese modern CICs

Some scholars theorized that the urbanization starting from 1949 in China was influenced by the Soviet concept of "social condenser" (Bray, 2005, Zhang and Chai, 2014). "Social condenser", with rich connotations integrating housing, production, intellectual work and workers' clubs into a life structure as well as passions for future life beyond ideology, had also been interpreted as a form of architecture but not limited to materialist perspectives in terms of political economy from the 1920s (Murawski and Rendell, 2017, Murawski, 2017a, Murawski, 2017b, Kopp, 1970, Stanek, 2008). For Kopp, though he had a series of specific functions composed in his mind, the "social condenser" was targeted much more towards a possible future society than describing the Soviet Union of his time (Stanek, 2017, Kopp, 1970). The social condenser concept in the above studies has a more significant influence on architectural form (a new architecture form with complex functions) than on urban planning because its practices were confined within the domain of architecture design. In contrast, for the industrialization and population organization in Soviet cities, the communities called "mikrorayons" (a type of open residence community with mixed services) which combine housing, kindergartens, schools, basic shopping and eating facilities, etc. were constructed close to industrial areas and surrounded central urban areas of major Soviet cities (Grava, 1993). In addition, Stenning (2005) stressed the importance of work place, which dominated everyday life in the Soviet Union. However, these soviet work places and residence areas were not constructed within enclosures and gates which fortified and distinguished the independent management of urban space use for integrated production and consumption in modern CICs of China.

In contrast, the Chinese work units provided for almost every conceivable need and benefit for workers (Womack, 1991), realizing this within the enclosures and gating systems of large-scale modern CICs. In contrast to the concept of "social condenser", a metaphor for a new architectural form and future lifestyle, the modern work units CICs have an impermeable urban morphology for collective job and housing. On the other hand, compared with the open state of living environments in "mikrorayons" and nearby independent industrial areas (Tomba, 2010), work unit CICs managed population within their enclosures as basic urban cells, which also made up for the inadequate supply of public services through independent production. The self-contained management that was encouraged by the central government in rural areas during the war period before 1949, was inherited by the modern CICs for social/industrial production (Bray, 2005). Within the enclosures and gates, colleagues and their relatives in work unit formed a small acquaintance society (Lu, 2006) with a not-for-profit feature. Moreover, between 1949 and 1978 the descendants of workers would have the chance to remain in and work in the same work unit. Work unit management and municipal governance were also divided based on the stable enclosure-gating systems which functioned as the borders of different jurisdictions between work unit and municipal government. Accordingly, the work units further consolidated self-management inside CICs, which resulted in the construction of modern CICs in China a distinctive existence. Though the Russia experts aided the construction of Chinese work units, the social condenser and mikrorayons on Soviet cities had limited impact on the construction of modern Chinese work unit CICs.

3.2 The enclosures and gates in two different space use systems: gated communities and work units

3.2.1 Social stratification: gated communities in modern China

Some scholars (Xu and Yang, 2009, Yao and Wei, 2012) studied the gated residential enclaves in China from a historical angle to examine the traditional living spaces within enclosures and their continuity/transformation in current urban planning systems of China. However, not all gated communities, including courtyard houses, royal palaces, modern work units and commercial communities in China can combine the work and private life together in a balanced manner. Moreover, the concept of gated communities in modern urbanization mainly refers to the commercial residence projects developed in the USA and China. Scholars examined the roles of the developers, designers, local governments and residents in the design, management and utilization of gated communities in modern China (Yao and Wei, 2012, Deng, 2018, Huang, 2006). As a product of the market reform, the appearance of gated communities in China replaced the welfare housing system implemented by work units from before the 1990s. Though most gated communities of commercial residence in modern China also have enclosures and gating systems, they mainly function as the residence areas for people who can afford the housing prices and rents. Due to real property values obeying market transaction regulations, gated communities function as clubs for owners from similar social classes. Gated communities with different qualities in design and supporting service classified the wealthy and poor as well as produced neighbourhoods excluding the outside public (Huang, 2004). The social stratification between different classes and spatial segregation between residents inside and public individuals outside perpetuated by gated communities were also criticized by scholars (Morgan, 2013, Vesselinov et al., 2007). Without the deep integration of collective social/industrial production, a gated community cannot act as a work unit CIC to balance the job and housing of citizens.

3.2.2 The socio-spatial mix inside the enclosures of modern CICs in China

Liang Sicheng (1949) classified urban life into four major functions: residence, work, leisure and transportation. The short distance between housing and job as well as a planning to avoid the negative effects of urban vehicle transportation were highlighted by Liang Sicheng at the very beginning to reconstruct the post-war cities in China (Lincoln and Tao, 2017, Gerth, 2017). Specifically, the security and health design proposed by Liang Sicheng including simple residence buildings with nearby gardens and adequate sun/fresh air, leisure places far away from public roads, school/work places accessible on foot from residential buildings, fewer roads as well as reduced risk of accidents from vehicles. Due to Liang's prominent reputation in the study of architecture and urban planning, the above concepts, including land use mix, good accessibility and neighbourhood security, also influenced the construction of work units in Beijing. Though Liang did not call for the construction of enclosures and gates for work unit CICs, the desire to avoid risks from public roads and vehicles as well as the pursuit of safe internal walkways did not conflict with the segregation of CIC spaces. The threat of public vehicles and strangers were reduced by walls and gates of work units, which were regarded as effective urban management tools (Bray, 2005).

On the other hand, Wu (2005) argues that the high level of social mixing inside the enterprise CICs led to that the unfair social exclusion through the gating system became impossible because no one could differentiate between those who lived within the CICs and the general public. Additionally, due to the dual structure of urban and rural areas peasants were segregated from factory workers in work units, which made it impossible for peasants to settle down in work units as registered residents. However, with a fair system of higher education entrance examination for students and recruitment criteria for young scholars grew up from both rural and urban areas, the individuals from different social strata and different regions shared the public welfare/service systems based on egalitarianism inside campus CICs. In particular, the campus CICs had a high population mobility every year due to the enrolment of new students and graduation of students. Based on the influence of egalitarianism (Wu, 2002b) as well as the resolution of hold-up problem through integrating both parties in the c (Deng, 2018), the highly mixed campus members still enjoy a modern CIC life with affordable dorms, food, leisure facilities and health care systems in urban China today. Though the gated communities have replaced the work unit system with the rising public commercial housing market during the past 30 years (Bray, 2005), the lack of job-housing balance means that no emerging urban morphologies can develop the socio-spatial mix integrating production and consumption as that developed in a work unit CIC.

3.3 Western experiences to promote urban vitality by increasing land use diversity and permeability

Jacobs (1961) praised the street where she lived in lower Manhattan, the open streets with mixed uses that created a vivid urban environment shared by a population with high social mix, which further enhances the security of local neighbourhoods. In particular, Jacobs argued that public security would be guaranteed with the eyes of passengers, customers, merchants and residents from various shops, restaurants/cafes as well as apartments along the open streets within small blocks (Wekerle, 2000, Cozens and Hillier, 2012, Brown et al., 2008). Western urban theories have also widely advocated diversity and spatial integration, which makes an important contribution to a vital urban life (King, 2013, Sung and Lee, 2015, Delclòs-Alió et al., 2019, Montgomery, 1998, Sternberg, 2000, Grant, 2002). However, spatial integration always faced a challenge from the justifying for social segregation/stratification, which was criticized by Jacobs and her supporters (Steil and Delgado, 2019). In theories of new urbanism[12], scholars concurred that land use mix can reduce the vehicle miles travelled (VMT) and automobile mode share (AMS) as well as enhance physical activity in the neighbourhood (Rodríguez et al., 2006, Crane, 1996). The walkable environments produced by land use mix were valued by consumers but inevitably raised housing prices (Matthews and Turnbull, 2007). Though the new urbanism approach focused on residence communities with job-housing balance, the quality of life was undermined by pollution produced in the land use mix in urban US (Angotti and Hanhardt, 2001). Moreover, the gentrification as well as growth management (Godschalk, 2004) also means that multi-approaches and a comprehensive set of concerns should be integrated into the future planning practice. In contrast to that, a variety of functions united in an open neighbourhood were promoted as increasing urban vitality, how the land use mix combining job and housing within enclosures functions in urban China has also been examined in this dissertation. In addition, new tactics should be developed to examine the land use balance based on the increased dynamic distribution of areas with high vitalities.

Enlightened by western theories, scholars have developed new methods based on the data of POI, night lightening and GPS tracking, etc. to explore urban vitality issues in China. Long and Huang (2019) analyse relationships between urban design (at the scale 1km×1km) and economic vitality[13] in urban China through examining the influence of intersection density, land use mix and accessibility. Xia et al. (2020) analysed the relationship between land use intensity and urban vitality at street block level in five Chinese megacities. The floor area ratio and building coverage ratio are employed as

[12] According to the definition from the article "A typology of New Urbanism neighbourhoods" written by Dan Trudeau (2013): "New Urbanism is an urban design movement advocating the creation of compact, mixed- use, and mixed-income human settlements."

[13] Data about social media comments, sign-ins and housing price data represent the economic vitality in above study.

proxies for land use intensity. Urban vitality is comprised of day-time vitality (based on an analysis of POI data about small catering businesses) and night-time vitality (based on analysis of lighting data detected by satellite at night). Their study contributes to the compact development theory through exploring the spatial mismatch between land use intensity and urban vitality. Wu et al. (2018) explored the relationship between urban form and neighbourhood vitality through the analysis of land use mix, transportation and GPS-based activity survey, etc. The authors selected Qinghe street community in Beijing to examine the high density, moderately mixed land use as well as inefficient external traffic systems which promote the neighbourhood vitality. The above scholars have successfully broadened Chinese urban vitality studies by combining western theories and big data analyses. However, few of them apply the heat map analysis to infer the real population densities in hour-based times to examine the space use vitality, which has been employed in the study of CICs in modern China in this dissertation. In order to enrich the land use mix theory as well as urban vitality theory by exploring the particular CIC context in China, the specific population densities and their locations in real-time are examined to evaluate how the mixed uses of different function in the spaces of a CIC are stimulated, which revealed the space use vitality from a smaller granularity and more dynamic perspective in CICs of China.

3.4 The construction and destruction of modern CICs influenced by social consumption, production and governance

Families or lineage forms close ties among individuals, which further influenced the habitat morphology including collective settlement constructed by clan members in rural areas as well as court yard housing for families in urban areas of Chinese society (Bray, 2005). In particular, the awareness of being a member of a family with strong collectivist bond is diffused from the family domain to local public administration system between neighbourhoods. For example, through the Bao Jia system in ancient period starting from Song dynasty, the rural society created a solid foundation for the collective organization of local consumption and production, which was passed down and transformed into present work units and residents' committees (Huang, 2006). The work unit system developed between 1949 and 1990 as well as residents' committees (RC) under the control of street office (SO), developed in 1990s, became the grassroots organizations for social management (Bray, 2006, Breitung, 2012). Moreover, the establishment of the SO was based on the weakening of uniformity and collectivity of the work unit in a commodity economy oriented social reform (Lu, 2006, Wu, 2011). The gated commercial residence communities replaced the role of housing supply with work units but kept the RCs as an extension of central governance. However, in contrast to the social mix inside work units, the increase in gated communities leads to new segregations of different classes as well as a strengthening of inside and outside.

The construction of work units within walls was perceived as a social management tactic without aiming to segregate different social classes (Bray, 2005). The social mix inside (Wu, 2005) work unit CICs is integrated into the collective lives of colleagues with equal housing situation, food supply as well as other public services before 1978. Moreover, social production and consumption are controlled by a bureaucratic system from the central government to local organizations (Weber, 2015, Whyte, 1973, Lu, 2006, Huang, 2006).To some extent, the collective life style is diffused from the governance of ancient farmland production to the governance of modern urban industrial production. However, to some extent, the division of administrative jurisdictions between work units and municipal management leads to the devolution of power from central government to the local authorities, which contributes to the independent management of work units. How this situation further influences the construction and transformation of CIC spaces is examined in this dissertation.

3.5 Research hypothesis

Though they have low spatial permeability, CICs in China function as a tool for managing urban population. In contrast to CICs in pre-1949 China as well as old inner cities in present China, the differences of socio-spatial governance and social life styles in modern CICs constructed by work units have been examined. In addition, the application of real-time big data uncovers the socio-spatial interactions in selected study cases. After experiencing the socialist period as well as market-oriented reform, modern CICs in China have become surrounded by high-rise public buildings with high density and FAR.

In this dissertation, I demonstrate the truthfulness of the CIC lineage spanning ancient dynasties and the differentiations between Chinese CICs as well as the socio-spatial influences of political control and economic production from agriculture and industrial societies on the typical CICs including imperial/palace cities and modern work units.

The study of modern CICs of work units is the main focus in this dissertation. I further demonstrate that the space construction and transformation of modern CICs support a high population density with an enlivened and balanced space use mechanism within current enclosure-gating systems.

Chapter IV

RESEARCH METHODOLOGY

4 Research methodology

4.1 Specific case studies

4.1.1 The pre-1949 case studies

• The case studies before Three Dynasties

The remains of Teng'hua'luo reveal a small city inside the larger city, providing researchers insight into the structure of the earliest CICs in China. Teng'hua'luo and many other cities have the similar urban structure during the Longshan culture period (Wang, 2017). Teng'hua'luo has been selected as a representative case in this study. In addition, Tao'si, another ancient in prehistorical period, will also be examined in this dissertation.

• The case studies in Three Dynasties (Xia, Shang and Zhou)

Three dynasties produced early Chinese civilization and created the earliest states recorded by historians. Erlitou, the capital city of Xia (Or Shang, according to some scholars), had a palace city in the urban centre. Shang city in Yan'shi has been selected because of the triple-wall structure in the archaeological remains. Compared with Yan'shi, the Shang city Zheng'zhou has a larger area but without detailed data about its quadruple city walls as defensive enclosures. Consequently, in this dissertation, only the triple-wall structure of Shang city Yan'shi will be examined. The Shang city Yin'xu has not been selected as a CIC case due to the lack of evidence. For the similar reason, Feng'jing and Hao'jing have also not been selected as CIC cases. King City Zhou (*周王城* Zhou Wang Cheng) and Cheng'zhou *成周* had typical CIC structure which deeply influenced later dynasties after Qin and Han dynasties. Only two cities have been chosen from Spring and Autumn period as well as from Warring States period. Simultaneously, the traditional CIC structure was not employed by other capital cities for different states during the radical social changes from Spring and Autumn period to Warring States period.

• The case studies from Qin dynasty to Qing dynasty

From Qin dynasty to Qing dynasty, about 10 large capital cities were built by different unified dynasties. The capital Xian'yang of Qin dynasty was a starting point for empire history and exerted a strong influence on the Han dynasty. During Three Kingdoms period, the reform in urban planning lead to the typical CIC structure produced in Zhou dynasty and this structure was continued during Tang dynasty. In the dynasties after Tang dynasty, some of the core capital cities with a CIC structure are selected and they are Bian'jing, Lin'an, Nan'jing and Bei'jing (see Figure 4.1).

City name[14](Dynasty)	Area of CIC (palace city /small city) km^2	CIC within 2nd ring of city wall_ km^2	CIC within 3rd ring of city wall km^2	Total area of the city km^2	Population Thousand
1. Teng'hua'luo (Longshan culture)	0.04	*	*	0.14	3
2. Er'li'tou (Xia/Shang)	0.108	*	*	4	25
3. Shang city Yan'shi	0.04	0.8	*	1.9	60
4. Shang city Zheng'zhou	0.37	3	**	3.17	100
5. Yin ruins (Shang)	*	*	*	4	120
7. Feng'jing (Western Zhou)	*	*	*	9	80
8. Hao'jing (Western Zhou)	*	*	*	4.5	70
9. King city Zhou (Eastern Zhou)	0.62	*	*	9	174.5
10. Cheng'zhou in Luo'yang (Estern Zhou)	***	*	*	4.8	93.1
11. Lu'cheng (Spring and Autumn Period)	1.56	*	*	12.45	109
12. An'yi (Warring States period)	0.75	6	*	13	224

[14] In the dissertation, the name of ancient cities will be separated by (') between syllables to show the difference with modern cities with the same name. For example, name of ancient Bei'jing and modern Beijing will be differentiated with this writing method.

13. Xian'yang (Qin)	***	***	***	165	650
14. Chang'an (Western Han)	27	*	*	36	240
10. Luo'yang (Eastern Han)	4.7	*	*	9.5	150
15. Ye'cheng (Cao Wei)	0.6	*	*	4.08	70
10. Luo'yang (Northern Wei)	0.92	9.5	*	100	600
15. Ye'cheng (Northern Qi)	1.32	9.6	*	85	600
16. Chang'an (early Tang)	4.2	5.2	*	85	1000
17. Luo'yang (Tang)	1	4.2	*	47	500
18. Bian'jing (Northern Song)	1.14	8.34	*	52.5	1200
19. Lin'an (Southern Song)	0.5	13.3	*	245	2500
21. Nan'jing (Ming)	1.01	4.5	43	230	2000
20. Bei'jing (Yuan)	0.74	5.4	*	51.4	1100
20. Bei'jing (Ming)	0.72	6.87	35.57	61.95	850
20. Bei'jing (Qing)	0.72	6.87	35.57	61.95	1080

Notice:

*** without archaeological findings; ** without detailed data; *** Without findings or still in dispute.**

The *2nd or 3rd city walls defined here would only exist if there was an outer city wall arounds them.*

Table 4.1. The selected main ancient capital cities in China and their defence enclosure systems with respective urban populations. Table drawn by author with reference to (Du, 2017, Zhao, 1994, Zhao, 2006a, Song, 1993, Lin, 1986, Lei et al., 1995, Jiang, 2002, Zhou, 1981, Zhao and Zhou, Song, 1994b, Tang and Du, 2008, Lai, 1991, Han, 2002, Du, 1998).

4.1.2 Two pre-industrial towns surrounded by modern urban areas constructed after 1949

• Pingyao ancient city: a CIC as well as a World Culture Heritage

Pingyao and Datong have been selected because their unique attributes are based on the enclosure system which is one of the main physical features of Chinese CIC. Pingyao was the first ancient Chinese city that was granted as a UN world Culture Heritage. The situation of Pingyao is quite similar to Regensburg and Classical Weimar in Germany. During the urbanization process, the old towns were surrounded by newly built urban areas and became heritage cities within a modern urban environment.

• The old town of Datong: a CIC constructed like an ancient city

Datong, an ambitious city that had repaired (almost rebuilt) the old city walls, 7.4 km in length, tried to rebuild the ancient-style buildings within the walls through removing residences, offices and service areas built after 1949, both in and outside the walls. Surrounding the old town, there have been large modern urban areas. A new city area (Yudong new city, Datong) is being built to the east and divided with the old town as well as the west city surrounding the old town by a green belt.

4.1.3 Work units built after 1949: the case studies in Modern Beijing

• University campuses

Fifteen universities have been selected in a regression analysis, based on the definition of the biggest CIC cluster area in Beijing. Among these case studies, the BUAA, USTB and PUHSC campuses have been selected as examples in the analysis of fragmented CIC boundary spaces as well as the spatiotemporal integration degree (STID) of the gating system on the boundary.

• State enterprises

Three case studies in Chaoyang district have been selected. They are located from north to south in the urban area between the fourth and fifth rings of Beijing. 798 Art District is known worldwide and it was also a pioneer in transforming industrial heritage buildings and reusing them as art studios and galleries. Laijin Culture Creative Industrial Park is the second case study, with a different form of transformation. Though the transformation building projects of 898 are not complete, it has already started to provide office and exhibition spaces and related public services to the public.

• Government agencies

In this study, there is less focus on the CICs built for government agencies, and there are two reasons for this. First, the agencies' CICs do not all have a significantly higher population density than that in surrounding urban environments. Second, most of the working zones in government agency CICs have rigid regulations to forbid the public visit, cwhich makes the in-depth field study impossible. In contrast, the high-density campus and transformed spaces in those enterprises will be the main focuses in this dissertation.

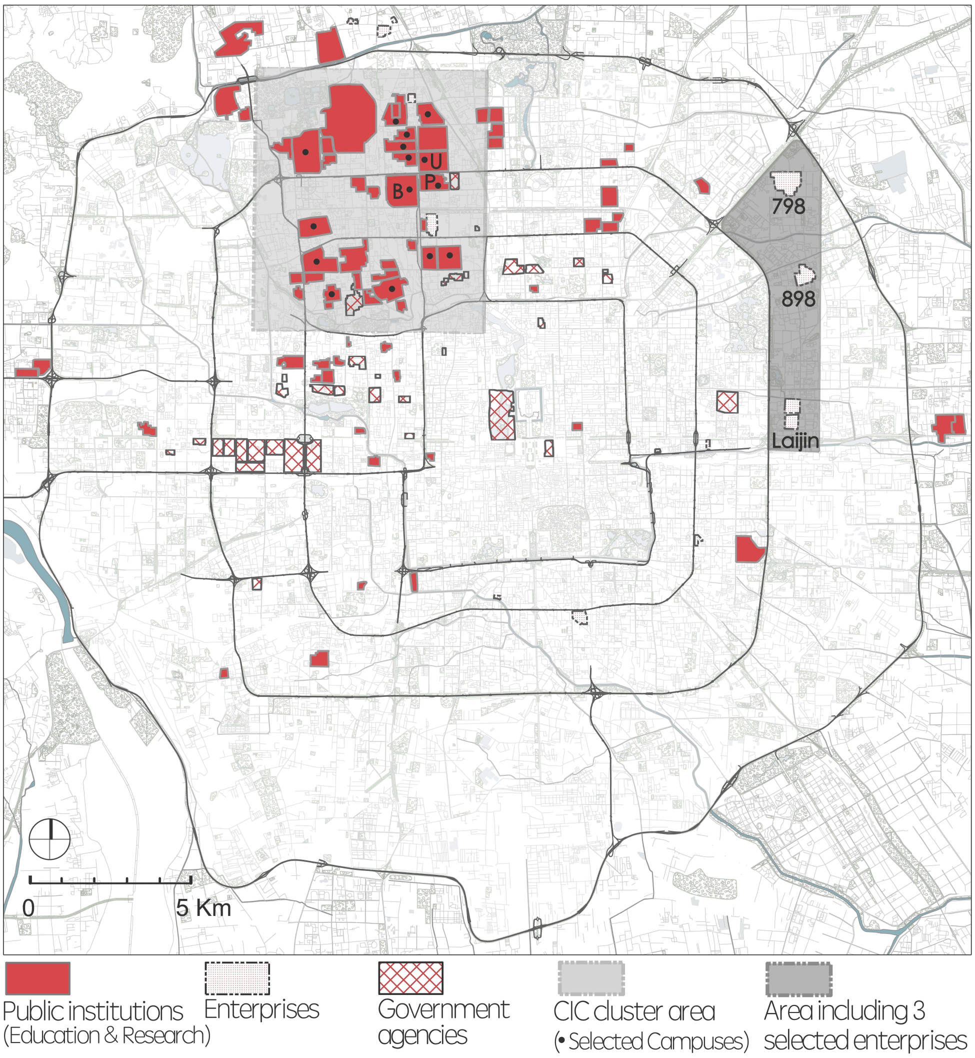


Figure 4.1 The locations of 120 work units and their CICs, mainly within the fifth ring of Beijing. The location of second ring was originally occupied by the city wall of old Beijing. (Figure: drawing by the author.)

4.2 Data and methods

4.2.1 Research data

• Data collection and literature review

The selection of existing archaeological research data and map-drawing for the comparison between different CICs

The data on CIC structures and population management in capital cities will be examined in this dissertation, employing previous research findings published by historians and archaeologists. To realize this aim, the spatial data of inner cities and palace cities of specific ancient capital cities have been collected. In particular, the data collection and analysis in archaeological bulletins of specific urban divisions as well as different urban population densities should reveal the space use mechanisms of ancient CICs. The mapping will also be grounded on a review of the urban planning of selected case studies. The maps of the selected cities are redrawn at the same scale, integrating previous archaeological research findings. The spatial comparison and its interpretation will also rely on the above work. In addition, the background research findings on global climate change (Hsu, 2014), social production as well as political and military control systems from the era of the ancient CICs (Morris, 2010) will also be integrated to reveal the construction of ancient CICs in China.

Ancient Chinese paintings depicting pre-industrial urban life

The ancient Chinese paintings primarily focus on the topic of city and palace life, from which the space use mechanisms of ancient CICs will be explored. In particular, the paintings entitled *Life Along the River in Qingming Festival* (*清明上河图* Qingming Shang He Tu) represented both the continuities and changes of city life from Song dynasty to Qing dynasty (Table 4.2). The two selected paintings of Han palace not only reflect the ancient royal life but also suggest the painters' own understanding of that life, based on their distinctive social backgrounds in Song and Ming dynasties. Finally, two paintings show life in the capital city in Qing dynasty from contrasting perspectives will be compared.

There are no sufficient imaging data (videos and photos) for us to explore the actual life inside a CIC, but these paintings enable me to distinguish between the daily activities in ancient CICs and those in modern CICs. The structure of city enclosures and gating systems as well as the activities and the population densities either real or imagined recorded by the painters active at different times from each other are also reflected in these paintings. Combined with a review of the historical records, the planning and management of ancient CICs will become clearer.

Creating time	Painter	Resource from Museums
1.Song dynasty	Zhang Zeduan	© Palace Museum in Beijing
		
2.Yuan dynasty	Anonymous	© Gehua Huiguan
		
3.Ming dynasty	Qiu Ying	© Museum of Liaoning Province
		
4.Qing dynasty	Painting Academy in Forbidden City	© Palace Museum in Taibei
		

Table 4.2. Life Along the River in Qingming Festival (Qingming Shang He Tu) painted in different dynasties. (Please see painting 1 and 3 in Figure 5.28 and 5.29).

Inferring demographic data in ancient capital cities of China

The incomplete records on population density and the vulnerability of traditional wooden buildings in heritage conservation remain obstacles to revealing the space use mechanisms of ancient CICs. Moreover, some of the existing descriptions in historical records contain fabricated or exaggerated information. For the demographic data that is lacking, methods developed by scholars to calculate population density based on archaeological remains will be referred to. In contrast to western cities where multi-story buildings constructed by stone and concrete contributed to developing a densely-populated environment, the dominant building technology employing wooden materials in China had not been surpassed by other material technologies until the end of Qing dynasty before 1912. Scholars have emphasized the low floor area ratio (FAR) in ancient

Chinese cities and imbalanced population distributions between different city walls rings (Zhao, 1994, Jiang, 2002, Song, 1993).

Jiang (2002) compared the methods of direct estimation based on the ethnic materials (Renfrew and Bahn, 1996, F.A.Hanson, 1991a, F.A.Hanson, 1991b) with indirect estimation methods. The direct methods always have bigger challenge of getting a precise inference on the indigenous population data without well-preserved city remains. The indirect methods rely heavily on inferences regarding inner resource consumption without considering the exchange of resources between different regions, which apparently does not correspond to the reality of the big capital cities in ancient China. Finally, scholars also infer the population density of ancient cities based on the construction technology, registration of household as well as population records in ancient China. For example, the new calculation factor with 290 m^2 per household in the urban area of Eastern Zhou dynasty (Jiang, 2002) is accepted in this study to infer population densities. Before Eastern Zhou dynasty, the density of 150-160m^2 per household becomes a common value to infer urban population density. The above inference methods were also based on the urban areas constituted mainly of wooden single-story buildings and high-density of buildings (50%) in ancient China (Hu and Cai, 2013). To divide the average value of how many family members in a household by the average value of how much area for each household (Table 4.3), scholars can infer the population density of specific areas in a capital city.

Though population data on specific CICs of the selected capital cities cannot all be determined directly from previous study findings (Huang and Xu, 2012), Jiang (2002) argues that the palace cities had a lower population densities than their surrounding urban environments. Moreover, the high rammed-earth platforms under those palace buildings did not increase the FAR of those palace cities. In this dissertation, inferring the population sizes of different cities and comparing the population sizes located in and outside ancient CICs provide access to ancient CIC life. In addition, the city population might differ depending on the locations in and outside CICs. On the other hand, social mobility including international trade and regional migration may also have influenced the population density in different areas within an ancient city (Zhang, 2008).

	Area per household (people/km^2)	Members per household
Cities before Eastern Zhou	160 m^2 / household (Song, 1993) 150-160 m^2 / household (Lin, 1986)	5 members / household (Song, 1993, Lin, 1986)
Cities from Eastern Zhou to Qin	150-160 m^2 / household (Jiang, 2002)	5 members / household in cities of Qin dynasty (Li, 2001) 3-3.5 members / household in cities of Qin dynasty (Wang, 1999b)
Western Han (Chang'an)	324 m^2 / household (Sahara and Zhang, 2001) Population in palace: 21,000 (Huang and Xu, 2012) 36 km^2 with 12,550 people/km^2 (Hu and Cai, 2013)	5 members / household within Li(里) and different densities in other areas (Huang and Xu, 2012)
Eastern Han (Luo'yang)	70-80 m^2 / household (Zhou, 2001)	5 members / household in residence areas and different densities in other areas (Fang and Xu, 2010)
Tang dynasty (Chang'an)	Population in palace city (55,000), Imperial city[15] (25,000) and outer city (623,000) in the late Chang'an (Wang, 1999a) 84 km^2 with 11,904 people / km^2 (Hu and Cai, 2013) 201-35,000 people / km^2 in a Fang (坊) (Zhang, 2018)	8 members / household (Gong, 1991) 6 members/household (Wang, 1999a, Zhang, 2008) 4.45-5.4 members/household (Tatsuhiko, 1994)
Northern Song (Bian'jing)	16400 people / km^2 (Zhao, 1994) 25,000-40,000 people / km^2 (Hu and Cai, 2013)	5.5 members / household 2.5 members / Kou (Zhao, 1994)
Southern Song	10,000 people / km^2 (Zhao, 1994)	5.5 members / household

[15] In capital city Chang'an of Tang dynasty, the palace city and imperial city were adjacent to each other. The former was mainly the living quarters of royal family members and also the working and meeting place of the emperor. While the latter was mainly for the work place of civil and military officials. Due to the close interaction and spatial connection between each other, the palace city and imperial city could be seen as an integrated CIC built for the empire' s ruling classes.

(Lin'an)		2.5 members / Kou (Zhao, 1994)
Yuan dynasty (Da' du / Bei'jing)	40,238 people in imperial city (Zhou, 1981)	5 members / household (Katou, 1959) 4.61 members / household (Zhou, 1981)
Ming and Qing (Bei'jing)	With different densities in commercial and residence locations of the city (Zhao and Zhou) 60.16 km^2 with 16,622 people / km^2 (Hu and Cai, 2013)	5-6 members / household (Zhao and Zhou)

Table 4.3. The estimated population densities in pre-industrial Chinese capital cities.

• Data collection based on the empirical observation of modern CICs

The heat map data collection and inference of population density

The big data analytics have been developed by scholars studying the Chinese urban planning issues with temporal scale granularity (Long and Huang, 2019, Long and Liu, 2016). In China, the apps Baidu Map and WeChat also are used by a huge number of people as the significant social media platforms (China Tech Insight, 2017, Quest mobile, 2016). In 2016, the number of WeChat users was 0.817 billion (Quest mobile, 2016). Three years later, in 2019, approximately 1.133 billion people were users of WeChat (Securities Times, 2019) and most of them were mainly Chinese. Among these users, the online payment system embedded in WeChat is much more common among urban users than rural users, which might be related to the more developed commercial services in cities. Urban geographers and planners have based their studies on the data collection and analysis of Baidu map (Wu and Ye, 2016, Ye et al., 2017) to discover the transportation issues in Shanghai. WeChat data (including the heat map data) was gathered from three-times more users than using Baidu map (Quest mobile, 2016). Combined with the analysis requirement to reveal user occupation of various mixed-use spaces inside CICs, data from the WeChat heat map with more users will be collected to infer the real-time population density in this study. Based on the findings that the homogeneity of population distribution on weekdays (Kan and Ma, 2018), the data of one day (January 3rd, 2018 / Wednesday) is selected from one week in the analysis of campus CICs. The data from

6:00 to 22:00 has been collected for every hour. In addition, the data comparing weekdays and weekends in summer and winter are included in the study of selected enterprise CICs to uncover their spatial transformation effects. A similar big data analysis has also been carried out on other selected case studies in this research.

Though the WeChat data might reflect the distribution of the urban population, it only represents a proportion of the population located in specific areas. To obtain more precise data on population density, an additional inference analysis has been done. Several dormitory areas in selected campuses provided a database for further inference of how many specific number of people the value of kernel density points represent. Due to the scarcity of dormitory spaces for the increasing enrolments, I assume that the dormitory areas are full. Based on official statistics and FAR which determine the whole population in a specific student dormitory area, the value of 40 can be used to calculate the specific population density on January 3rd, 2018. On the other hand, for the three selected enterprise CICs, the stable life style of residence areas in population distribution during winter and summer could be a frame of reference for the data in different seasons. In other selected case studies for ancient towns, the comparison of population densities in different urban areas would refer to their official demographics.

The land use mix observed in field study: with records by photos and videos which gives an idea cof the overall atmosphere

In the field study, about 20 campus CICs, 5 enterprise CICs and 2 government agency CICs were explored and documented. The CICs for the first two types of work units were investigate more thoroughly than the third type of CIC, which to some extent was determined by the accessibility of the study case itself. In this process, a deep immersed field work to probe into the local space use, incorporating photo and video records have been integrated into this dissertation. Those records which reveal the changes in a same place over the course of years will best reflect the spatial transformations in CICs. Because the clear classification of 8 main functions and 26 sub-functions of CICs has been developed by the author (Gu et al., 2019), the records of CIC space use are also standardized to make the records of different types of CICs comparable. The classification of land uses is based on the self-contained life within CICs. Though some CICs are losing their original collective life combining the living space and work space, the highly-diversified classification itself could still be applied in these case studies.

Classification (Main-function)	Specific Building function (Sub-function)	Classification (Main-function)	Specific Building function (Sub-function)
1.0 Institution	1. Offices	**4.0 Culture**	14. Theatres and cinemas
	2. Teaching / Researching		15. Museums and galleries
2.0 School for Children/teenagers	3. Kindergartens		16. Conference halls
	4. Primary schools		17. Historical sites
	5. Middle schools		18. Libraries
3.0 Service	6. Markets and Shops	**5.0 Sport**	19. Gyms
	7. Hotels		20. Pools
	8. Canteens Cafés and Restaurants		21. Health clubs
	9. Service centres Staff club Logistics	**6.0 Other infrastructures**	22. Printing presses Power plants Inner bus operation-centres Indoor playgrounds
	10. Hospitals	**7.0 Residence**	23. Staff dormitories
	11. Bank		24. Student dormitories
	12. Post offices Express stations		25. Commercial and residential complexes Commercial housing
	13. Public security	**8.0 Landscape**	26. Playground Squares/gardens/Roads

Table 4.4. The classification of land use mix in CIC with 8 main functions and 26 sub-functions. Resource modified according to (Gu et al., 2019).

The data about Points of Interest (POI)

The POI data revealing the specific locations of the land uses on the Baidu map are collected and employed to analyse selected enterprise CICs, some of which have highly-complex and compact land uses due to spatial transformations without land use zoning during the market reform. For example, since 1990 the original industrial production areas of 798 Art District have been filled with a variety of companies and institutions, resulting in the mingling of different functions, including galleries, museums, restaurants, art/design studios, shops and high-tech offices. The original zoning plan inside the CIC has been ignored, and identifying land uses by their original land use areas (km^2) does not reflect the reality of present day land use mix. In line with other urban planning researchers (Li et al., 2018, Yue et al., 2017, Li et al., 2016), this dissertation utilizes POI data to determine the degree of land use mix by applying an entropy calculation.

GIS mapping based on the data in Baidu map and Tencent map

In this dissertation, the shape file (polygon) of buildings with detailed information about the number of stories and the scale have been obtained from the platform of Beijing City Lab (BCL). Other files focus on the transportation system, green land, the water system within the fifth ring of Beijing as well as the enclosure and gating systems of CICs have been gathered through GIS with the collected map data in the Baidu map. In addition, the information about specific functions of buildings in selected studies was also included to the shp files in GIS based on field studies as well as data referenced in the Baidu map and the Tencent map (the base map of WeChat data). Based on the above data and POI data, the spatial features with 2D or 3D illustrations have been examined in this dissertation.

Interviews with local space users, managers as well as scholars

Interviews with local space users, managers as well as related scholars have been integrated into this study. In the comparison of three selected enterprise CICs, the managers of the original work units have also become the managers of service and working spaces rented to those private companies in the market based economy. Combined with the findings in interviews, the big data analysis will be embedded in the reality of the space use experiences as well as demands of inhabitants in present day CICs in Beijing.

4.2.2 Research methods:

• Examine the construction, transformation and space use of CICs in China

To reveal the lineage of ancient CICs, the urban structures, governance and population densities of selected capital cities will be compared with those of different dynasties. Combined with the study on economic production and political control in ancient China, the space use/transformation mechanism of ancient CICs will be uncovered. This step also sets a suggestion for further scientific work exploring the continuity and change of CICs from empire China before 1912 to modern China after 1949.

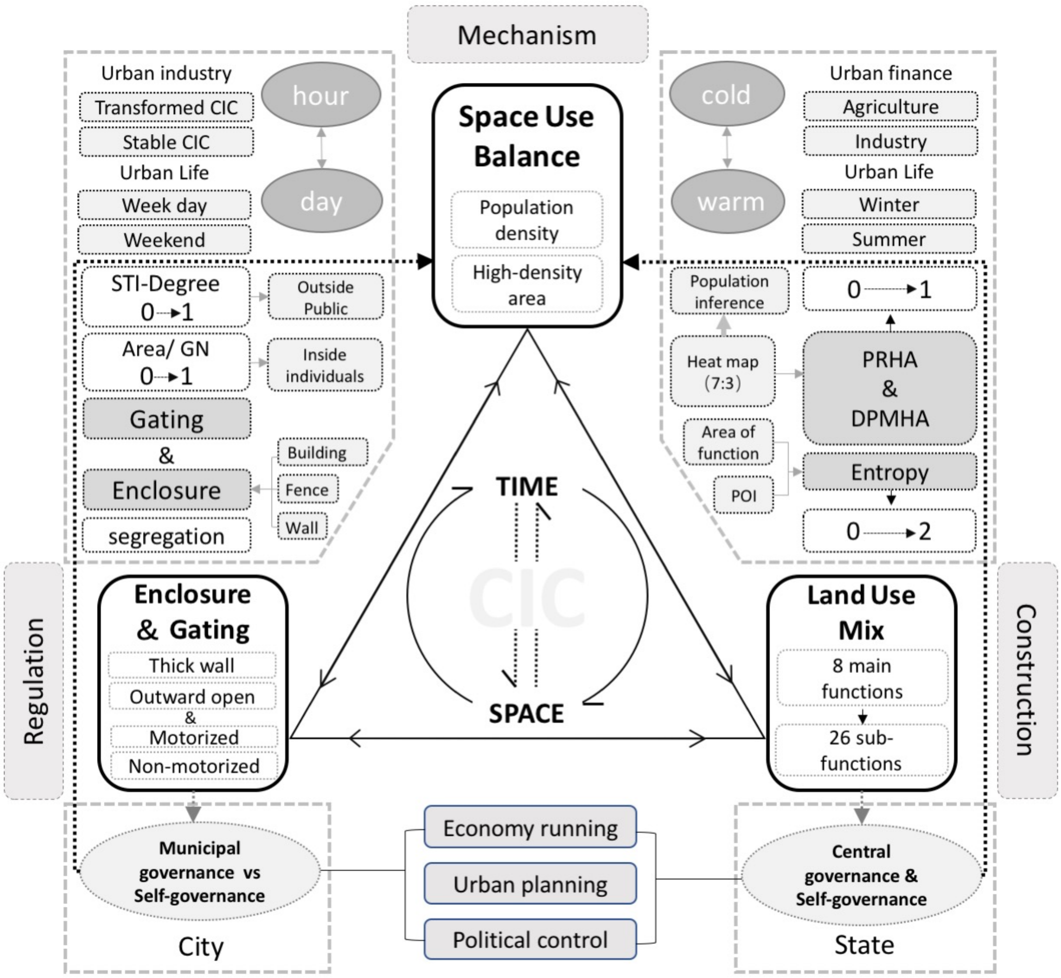


Figure 4.3. The outline for analysis of space use integrating the three main attributes in modern CICs constructed by work units. Figure drawn by the author.

On the other hand, to uncover the space use and transformation of modern CICs in present day China, the combination of big data analysis, the field investigation and the exploration of social influence factors, including economic production and political control, will reveal the relationships between the space use balance, enclosure and gating systems, as well as the land use mix in modern CICs (see Figure 4.3). Finally, the exploration of ancient towns in modern urban areas highlights particular differences among modern CICs constructed by work units in urban China.

• Land use balance: a method based on the analysis of local population density, distribution and its scale in real time

In contrast to the population inferences of pre-historical capital cities and some of their CICs, the population of Beijing and its CICs can be calculated using existing demographic data or inferential from big data analysis. In particular, the specific population densities and can be inferential based on the heat map data analysis from GIS, which also illustrates the high-density areas within every CIC. Moreover, the analysis is based on the real-time data collected every hour from 6:00 to 22:00 on a single day. Therefore, the types of land uses are stimulated by which population densities in the specific time periods of a day can be revealed, which suggests a dynamic new parameter for evaluating the urban vitality, compared with relatively static data of land use mix (e.g. POI data).

The data from the WeChat heat map will be collected and analysed by employing 7 classifications created by a Natural Breaks method of Kernel Density Points analysis in GIS. The proportion of denser areas of the top three grades could be counted (Gu et al., 2019) as follows:

$$\boldsymbol{PRHA = \frac{a_n}{A}} \tag{1}$$

PRHA is the proportion of real-time high-density areas of a CIC, $\boldsymbol{a_n}$ is the high-density areas in a specific hour, And $\boldsymbol{n}$ represents the time (n=6, 8, ……, 22).

In this dissertation, it is found that the population densities inside campus CICs are much higher than that of the surrounding urban environments. Moreover, the even population densities during working and residence times in CICs within the cluster area (Figure 4.1 and Figure 6.27) respectively reach to 60,000 and 40,000 people per km^2, which reflects the high population densities of modern CICs. Based on above findings, I combine the comparison of population densities and PRHA value in specific times of a day to uncover the land use balance within a CIC in a dynamic way (see the example in Figure 6.33 and Figure 6.35). The decrease of PRHA between two specific hours reveals a more scattered population distribution during that time, which suggests that the land uses inside that CIC during this period becomes more balanced than before. If the PRHA in specific hour increases, the population will become more concentrated, which also suggests different land uses are becoming more unbalanced. Based on above methods, the dynamic change of land use balance between different hours can be summarized. In particular, when the population density of a CIC grows between two hours, the decrease of PRHA will suggest that the mixed-use spaces inside the CIC evenly distribute the increasing population. On the other hand, though the population decreases, a campus CIC still maintain a high population density, which suggests the decrease of PRHA still contributes to transforming the land uses to a more balanced state.

$$\boldsymbol{DPMHA} = (\boldsymbol{a_6} \cup \boldsymbol{a_8} \cup \ldots \cup \boldsymbol{a_{22}})/\boldsymbol{A} \qquad (2)$$

In the above formula, DPMHA (daily proportion of merged high-density areas) is based on dissolve analysis of all the high-density areas during different times of a whole day in GIS. $\boldsymbol{a_n}$ represents the high-density area of a specific hour and $\boldsymbol{n}$ represents the one specific hour in that day (n=6, 8, ……, 22). Base on the analysis of DPMHA, the proportion of how many areas in each CIC have been stimulated by the high population densities (see top three grades in the description of formula 1) in one day will be uncovered. The higher value of DPMHA symbolizes a more balanced daily land use, which indicates that the larger proportion of spaces in a CIC have already taken the responsibility to serve high population densities (see the example in Figure 6.33).

• The analysis of land use mix: from the proportion of mixed-use areas to that of mixed-use points

Land use mix in campus CICs with a zoning plan: the entropy analysis based on the detection on specific scales of different land use spaces

In the field study of modern Chinese CICs, the land use issues connected with the various functional spaces has become one of the main focuses. The stable land use mix inside the enclosure and gating is one attribute that might deeply influence the activities of local individuals. The first-hand materials on the use of buildings is utilized to calculate the entropy of those campus cases. The building functions can be observed and classified according to main functions (8 types) or sub-functions (26 types). Based on these classifications, the proportion of functional areas of each CIC can be calculated, making possible the Land Use Analysis below.

To compare the entropy values of different universities, the whole campus will be counted as one unit when calculating entropy. Though the scales of these universities differ, the similar requirement to serve the students and staff leads to the homogeneity of their campus construction. Determining the functions of specific building areas also makes it possible to calculate a relatively precise entropy value for every selected campus CIC. Next, the fragmented boundary space and space inside a campus will be classified when calculating their respective entropy values to reflect the relationship between campus management and municipal governance.

Third, there are two aspects in calculating the land use mix. One is the balance of different land uses and the other one is the diversity of land uses. The definition of the former, developed by Frank et al. (2005), will be applied as in formula (3), (Gu et al., 2019). Here ***a*** represents the whole area of a campus (or the area of its inner spaces/fragmented CIC boundary spaces). ***b*** represents the floor area of a specific type of land use in the campus. And ***n*** refers to the number of all the types of land uses (8 main functions) in selected campus spaces. The latter aspect (about the diversity of land uses) will be considered here by emphasizing the importance of land use types by adding the weight of ***n/8*** into the analysis of selected campus cases.

$$\boldsymbol{Entropy} = \frac{\boldsymbol{-1}}{\boldsymbol{a\ ln(n)}}\sum_{i=1}^{n}\boldsymbol{b_i\ ln(b_i/a)} \tag{3}$$

Diversified land use mix to transform factories in enterprise CICs in fine granularity: the entropy analysis based on the collection of points of interest (POI) data

In the study of three selected enterprise CICs, the methods will be adjusted to highly complex functions and institutions developed in the economy reform. In order to calculate the land use mix of the smaller scale grids in CICs, the GIS fishnet that classifies the CIC with grids of 80m×80m was used in the analysis of the POI data and the related research method is referred to in the study by Li et al. (2018). In contrast to the campus buildings that each have their respective mixed functions based on zoning plan, there are highly functional mixes in industrial heritage buildings without classified primary and secondary functions. Therefore, the variety of functions, including canteens, galleries, shops and art/design studios, etc. in a building, makes the POI data a better choice for applying the entropy calculation within a smaller scale area.

The classification of 8 main functions and 26 detailed sub-functions will be attached to the POI points in this step of the analysis. In formula (4), T_i is the number of points of interest with the same specific function ($i = 1, 2, \dots\dots, n$) and T is the whole number of functions within selected area. And here $n = 8\ or\ 26$. P_i is the proportion of the number of POI points for one function in the whole number of POI points for different functions within the same selected area.

$$\boldsymbol{P_i = T_i/T = T_i/\sum_{i}^{n} T_i} \tag{4}$$

Hence, the entropy of selected area is:

$$\boldsymbol{Entropy = -\sum_{i=1}^{n} p_i \times \log p_i} \tag{5}$$

The entropy in formula (5) takes account of both the balance of different land use proportions and the degree of diversity influenced by the number of functional types. A higher entropy value suggests not only a greater equilibrium among different types of POI points but also a higher number of POI types. Based on the above formulas, the entropy in specific grids within selected case studies will be calculated as below:

$$\boldsymbol{Entropy} = -\sum_{x}^{a}\sum_{y}^{b}(\boldsymbol{T_{xyi}}/\boldsymbol{T_{xy}}) \times \mathbf{log}(\boldsymbol{T_{xyi}}/\boldsymbol{T_{xy}}) \tag{6}$$

Here the grid (with the size of 80m×80m) has been applied in classifying the selected CIC space into a rows and b columns. T_{xy} is the whole number of the 26 types of function points within the selected grid located in row x and column y ($x = 1, 2, \dots\dots, a$; $y = 1, 2, \dots\dots, b$). And T_{xyi} is the number of POIs with the same specific function i ($i = 1, 2, \dots\dots, 26$).

• The enclosure and gating system calculated using two methods

The first method: enclosure and gating system for members of a CIC

For the users of the internal spaces of a CIC, the enclosure and gating system mainly functions as security protection. Hence, the ratio between area (***A***) and the number of gates (***n***) in a CIC determines the spatial accessibility enjoyed by those local users. For the study of the space use mechanism of the selected campus CICs, I use the formula below to calculate the degree of enclosure with reference to Gu et al. (2019):

$$\boldsymbol{Enclosure\ degree} = \frac{\boldsymbol{A}}{\boldsymbol{n}} \tag{7}$$

The second method about spatiotemporal integrating degree (STID): dynamic enclosure and gating system mainly for public visitors

Here the spatiotemporal integrating degree (STID) is developed to reveal the dynamic enclosure and gating system set mainly for regulating public visitors. A key step in measuring the STID of a CIC is an analysis of the CIC's gates. While other studies applied the ratio to the number of gates and the length of the wall as a proxy for spatial integration (Frank, 2005), this study implements a more complex procedure to precisely measure the STID, namely, the integration degree between the CIC and public urban space. This concept integrates both spatial and temporal aspects, and the specific procedures are introduced below.

First, the spatial-temporal integration of each gate is calculated using formula (*8*). ***g*** is the integration degree of each gate and holds a value between 0 and 1, where 0 is the absolute close state of a gate and 1 indicates the absolute open state to public. $\boldsymbol{h_1}$ and $\boldsymbol{h_2}$ represent the number of hours the gate is opened to the public per day for motorized and non-motorized traffic (including walking, cycling, etc.), respectively. **d** refers to the number of days that the gate is open for the public to enter per week. ***S*** represents an adjustment parameter that reflects the spatial dimension of integration and is classified into three categories on the basis of a detailed regulation system: ***S*** equals 0.5 when public vehicles are prohibited from entering, 0.75, when public vehicles are permitted to enter and exit at the same gate, and 1 when there is no restriction on the entry or exit of public vehicles through any CIC gate.

$$\boldsymbol{g = \left(\frac{h1}{24}\cdot\frac{1}{2}+\frac{h2}{24}\cdot\frac{1}{2}\right)\cdot\frac{d}{7}\cdot S} \tag{8}$$

Second, the integration degree of each subarea within the CIC is calculated according to Formula (*9*), where ***SA*** represents the integration of each subarea, and ***n*** refers to the total number of gates within each subarea.

$$\boldsymbol{SA = \frac{1}{n}\sum_{i=1}^{n} g_i} \tag{9}$$

Third, the level of integration of a CIC's inner and boundary spaces is calculated with Formula (*10*), where ***STID*** is the overall integration of the CIC's inner or boundary space, ***a*** represents the area of the sub-area, and ***A*** refers to the total area of the inner or boundary space. ***n*** represents the number of inner or boundary subareas.

$$\boldsymbol{STID = \frac{1}{A}\sum_{i=1}^{n} SA_i \cdot a_i} \tag{10}$$

• **Logistic regression in analysing the space use mechanism of selected campus CICs**

A logistic regression analysis is conducted to explore the relationships between the dependent variables for land use balance (DPMHA) and independent variables including land use mix (entropy), enclosure and gating system (A/n) as well as other variables in table 4.5. Through the analysis of 15 selected campuses, the independent variables which have a more significant influence on the land use balance will be presented. Finally, the campus CICs which have apparent disruption to the R-square of the regression compared to other campuses will be selected for further explanation of their specific distinctions in CIC space use mechanisms.

VARIABLES	DEFINITIONS	SOURCES
Dependent variable		
Y: DPMHA	Daily proportion of merged high-density areas	By own calculation in Formula (2)
Independent variables		
X_1: Entropy (campus)	Entropy-based land use mix	By own calculation in Formula (3)
X_2: Enclosure (A/n)	Enclosure and gating degree	By own calculation in Formula (7)
X_3: Ranking	Ranking of University	www.gxeduw.com/daxuepaiming/beijing
X_4: Fund	Research Funding	http://www.moe.gov.cn
X_5: Gender_ratio	The ratio of female/male students	https://kknews.cc/news/ln6jnr9.html
X_6: Total_area	Total area of the campus	Baidu map + GIS analysis
X_7: Insti_area	Proportion of institution area	Baidu map + GIS analysis

X_8: Resi_area	Proportion of residence area	Baidu map + GIS analysis
X_9: Serv_area	Proportion of service area	Baidu map + GIS analysis

Table 4.5. List of the key variables in the regression analysis of selected campus CICs with their definitions and sources. Table adapted © (Gu et al., 2019).

Chapter V

CHINESE CICS: FROM THE ANCIENT PERIOD TO MODERN TIMES

5 Chinese CICs: from the ancient period to modern times

5.1 The continuity and transformation of ancient CICs across dynasties and regions

5.1.1 A historical and geographic overview of the selected ancient cities

To understand the relationships between CICs in ancient and modern China, a historical examination of the ancient cities will contribute to revealing the continuity and transformation of the CIC structures in different political and economic context. The earliest CIC structure seems to be found in Neolithic archaeological remains. The early Neolithic settlements along the Yellow river valleys were surrounded by moats between 6000-3500 B.C., which were distinctive from the walled settlements or cities appearing around 3000 B.C. (Tao, 1993). In ancient society, to support the urban population, the capital city were usually located close to natural resources, such as rivers, rich farmlands as well as geographical advantage of defence and travel routes to the outside world (Crawford et al., 2005, Li et al., 2014, Liu, 2003), which also influence the specific construction of CICs in the later appeared cities such as Er'li'tou, Chang'an and Luo'yang, etc.

Figure 5.1 contains 21 cities, 18 of which were once capital cities. The capital cities constructed before Southern Song dynasty are located along a west-east axis. In contrast, the capital cities constructed between Southern Song dynasty and Qing dynasty were mainly located from north to south and close to the east coast of the country. From the beginning of Er'li'tou (~1900 B.C.) in Xia dynasty, the China's great flood bursting at 1920 B.C. (Wu et al., 2016) started receding and stopped harming the villages and cities. After a cold and drought period between 2400 B.C. and 1800 B.C. (Table 5.1), the warm weather benefited the development of Shang dynasty (Hsu, 2014), which was replaced by Zhou dynasty at the beginning of next drought and cold period between 1250 B.C and 650 B.C. The Han dynasty was founded in 206 B.C., during the warm and wet period between 750 B.C. and 65 B.C., and ended in the next cold and drought period between 65 B.C. and 600 A.D. Later on, the warm and wet climate during 600 A.D and 1280 A.D. in Guanzhong plain and Guandong plain became favourable to form good farmland and rich vegetation, which provided a perfect breeding ground for the agricultural production and city construction in the coming Tang and Song dynasties (Zhu and Hu, 1998, Zhu, 1972).

After Northern Song dynasty, the capital cities were always located close to the east coast of China running from north to south, which to some extent was limited to the exhaustion of natural resources as well as water loss and soil erosion in central China. The dividing time point (1127 AD.) between Northern Song and Southern Song was close to the next cold and drought period between 1280 A.D. and 1860 A.D. Before that, the warm weather and fertile grassland had enabled the population of the northern nomad (Mongolian) population to grow, which ultimately helped lead to the fall of Western Xia, Jurchen Jin and Southern Song dynasties as well as the establishment of Yuan dynasty in the coming cold and drought period after 1860 A.D. Population growth in warm period, famine in the cold period as well as the military rise of north nomads led to the replacement of Song dynasty by Yuan dynasty (Hsu, 2014). Unfortunately, the cold and drought climate returned at the beginning of the foundation of Yuan dynasty which lasted only 98 years. The Ming dynasty (lasted for 278 years) also fell during the same cold and drought period and was replaced by the Qing dynasty. The north nomads (Manchu) established Qing dynasty in 1644 A.D. and maintained the agriculturally dominant economy, which also led to the downfall of the empire because of the Qing dynasty was complacent about its traditional agriculture production and despised the industrial revolution appeared in western societies. In conclusion, the periodic wet and drought period described by Hsu (2014) harmed agriculture and animal husbandry in ancient China (Table 5.1), which undermined the economic basis for the urban construction of capital cities, based on which the development and transformation of ancient CIC structures had to adjusted to the social governance and production in different dynasties.

In Figure 5.2, the CICs of some capital cities experienced the transformation from simple structures to more complicated structures in the period before Eastern Han dynasty. In particular, during Qin and Western Han dynasties, the multi palace cities appeared. However, the number of palace cities in capital city Chang'an decreased from Western Han (7 palaces) to Eastern Han (2 palaces). In Three Kingdom period, the CIC structure in capital cities became with single centre palace as well as concentric inner and outer city walls again as seen in Zhou's King City Map. Most CICs were palace cities for the ruling classes. However, in Northern Wei dynasty, the triple concentric city walls (case study 10 after case study 15 in Figure 5.2) created the inner city between the palace city and larger outer city, which suggests the appearance of CICs constructed to protect the growing normal citizens. After Northern Wei, the CIC structures did not experience significant changes until the fall of Qing dynasty. Even though the inner and outer city walls of Southern Song dynasty and early Ming dynasty were not square due to the complicated physio-geographic situations in south China, the concentric structure of CICs was still firmly part of city planning. Moreover, when examining the morphologies of Ye'cheng (case study 15) in the state of Cao Wei (Three Kingdom period) and Chang'an (case study 16) in Tang dynasty, they both located their palace cities within the north centre of the outer city and constructed orthogonal urban road systems, which shows the influence of urban planning experiences of the former one to the latter one (see Figure 5.18, Figure 5.22 and 5.23).

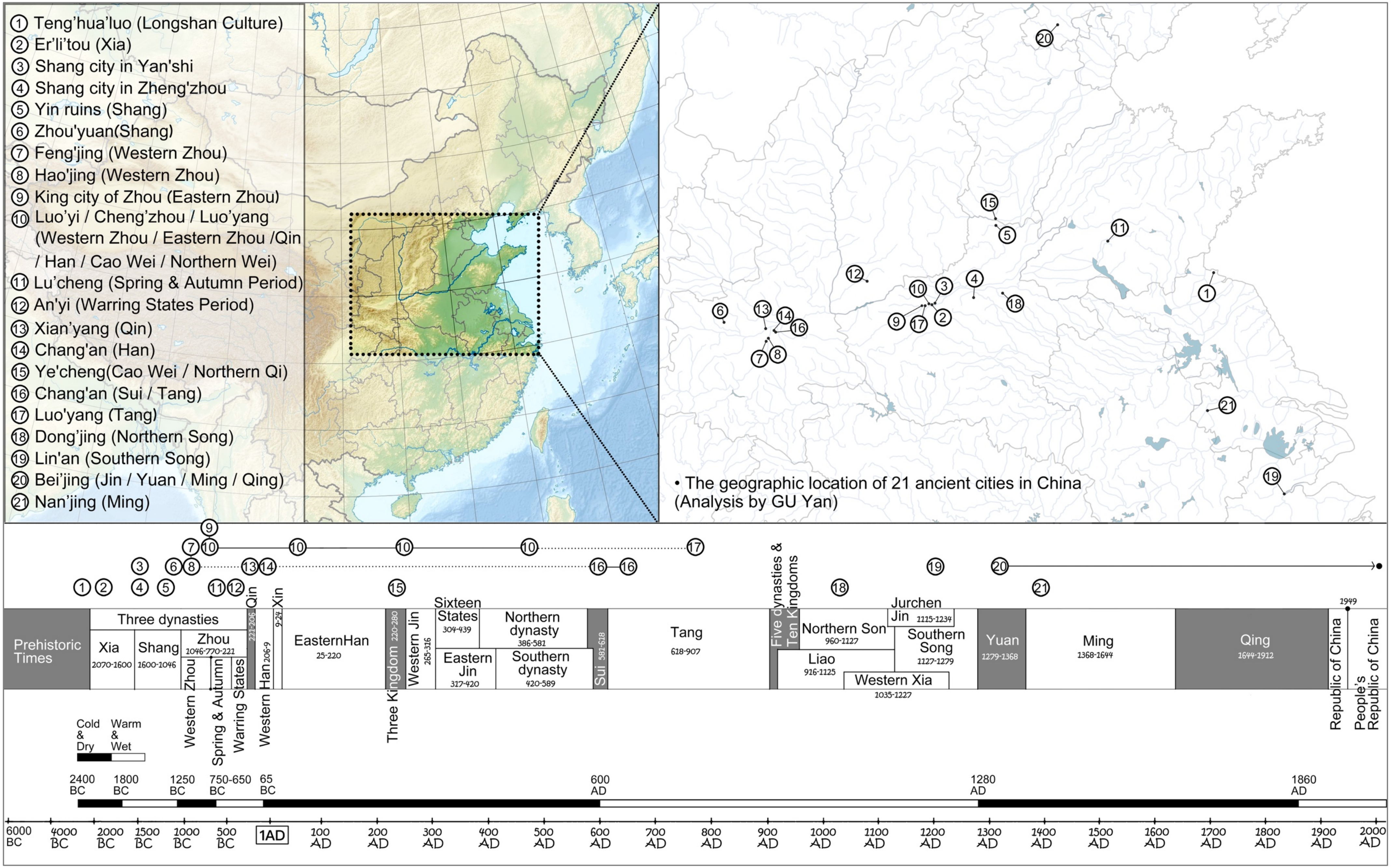


Figure 5.1. The 21 selected cities in ancient China with their temporal-spatial distribution. Except for the cities 1 and 6, all were the capital cities in different dynasties or states. Figure drawn by the author.

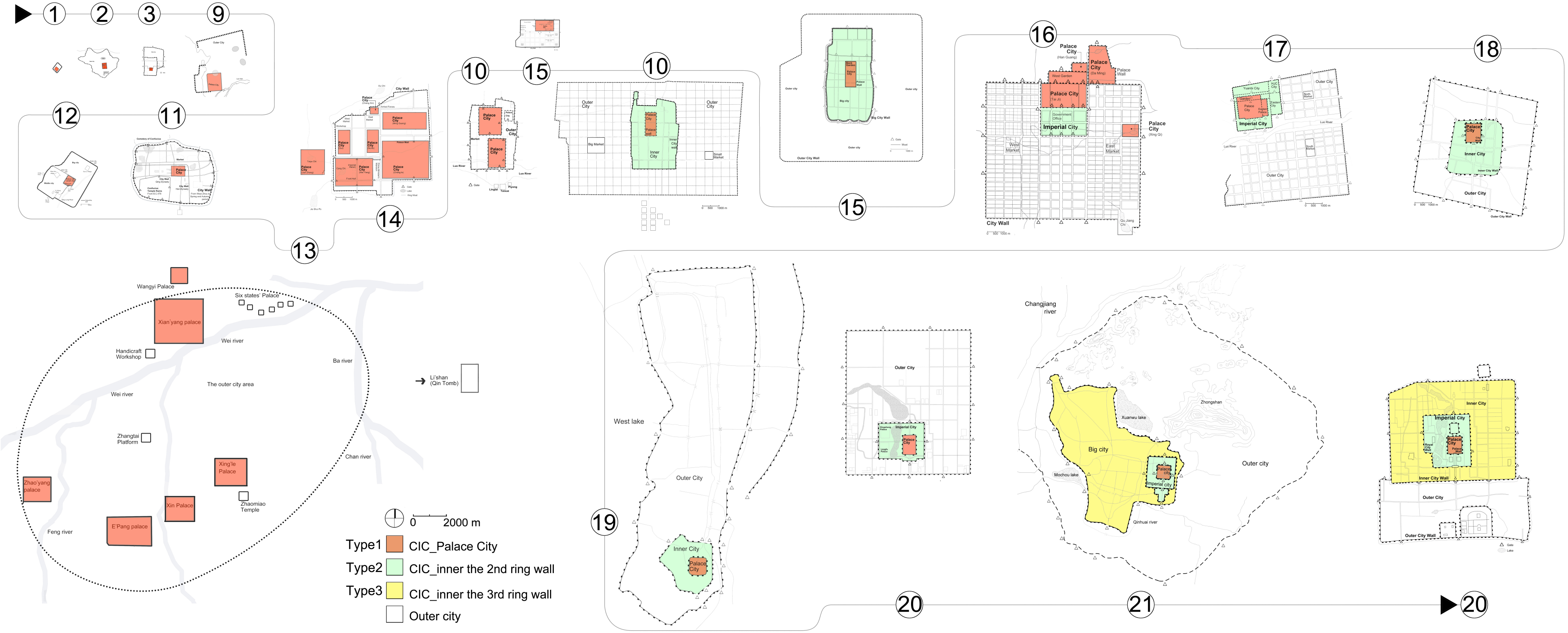


Figure 5.2. The analysis of CICs with the inference of city maps with clear CIC structures drawn based on records of archaeological remains. Figure drawn by the author.

Time	*2400 -1800 B.C.*	*1800 -1250 B.C.*	*1250 -650 B.C*	*750 -65 B.C*	*65 B.C-600 A.D.*	*600-1280 A.D.*	*1280-1860 A.D.*	*1860 A.D.-Now*
Climate	Cold and drought	Warm and wet	Cold and drought	Warm and wet	Cold and drought	Warm and wet	Cold and drought	Warm and wet
Dynasty	Xia dynasty	Shang dynasty	The end of Shang and Western Zhou	Spring and autumn Warring States	The end of Han Three Kingdoms	Tang and Song Rise of Mongol	The end of Yuan and Ming dynasties	Qing dynasty Modern China

Table 5.1. The change of climate from ancient to modern China and its influence to the history of Chinese civilization. Resource © (Hsu, 2014).

5.1.2 Teng'hua'luo: an example of Chinese CIC in stone age？

The ancient city Teng'hua'luo *藤花落* (case study 1 in Figure 5.1) was abandoned around the end of Longshan culture period（7000-4000 years ago）because of the great flood (Li et al., 2008). Based on a study of the archaeological remains, the inner city was located within the south of the outer city wall and contained 44 buildings which might have been constructed after the abandonment of the small inner city (Nanjing Museum, 2014). The circumference of the outer city wall is about 1520 meters with a north to south length of 435 meters as well as an east to west length of 325 meters. A road was located inside and along the outer city wall as well as a moat outside.

Zhang (2003) and Xu (2017b) wrote that the discovery of Teng'hua'luo remains revealed that the urban structure depicted on the King City Map of Zhou might derive from earlier ancient cities appeared before Zhou dynasties. The Xia dynasty, the earliest state in recorded Chinese history, lasted from 2070 B.C. to 1600 B.C (Dai et al., 2016, Wu et al., 2016). The late period of Teng'hua'luo was close to the founding time of the Xia dynasty, which might suggest a close relationship between the city Teng'hua'luo and those cities later constructed in Xia, Shang and Zhou dynasties.

However, there is still doubt about the function of the narrow space between the inner-city wall and the outer city wall in the south of Teng'hua'luo (Figure 5.3). The question is why the inner city wall was so close to the outer-city wall yet not combined to share the same part of city wall and why there was only a narrow space less than 10 meters wide between the two city walls. Wang (2017) explained that based on archaeological dating research the inner-city may have been built first and used until the construction of the outer-city wall was complete. A potential reason for constructing the big city surrounding the small inner-city was to protect the growing of population as well as a larger residence area in the new, longer city walls.

In addition, another possibility for the construction of the big city with a larger area on the north may be related to the utilization of waters from the close rivers. The ancient Chinese people always settled north and above nearby rivers but also with easy accessibility to the water for their daily needs. Because of the short distance between the first constructed small inner-city and the south rivers/lakes, the new big outer-city had to be constructed much more to the north with a south wall close to the original small inner city. During the construction of outer-city wall, the inside small city might become a temporal inner city and its use might have come to an end after the completion the outer-city wall. If this theory is right, it would be not hard to understand why there were a mixture of archaeological remains from different social classes in the inner city (Lianyungang Museum, 2013). The mixed habitation might also confirm the lack of distinction of spatial hierarchy between the inner city and outer city, which suggests that the inner small city is not a palace city. Therefore, the brief coexistence of the small city wall and the bigger outer city wall cannot prove the existence of a mature social stratification in Teng'hua'luo.

However, the short transition to a CIC structure might exist in late stone age cities like Teng'hua'luo due to population growth. This developmental step might provide a potential choice of CIC structure for the ancient citizens to adapt to further social differentiation from Long Shan culture to Xia dynasty, which led to the evolution of CICs from a temporary spatial structure to a permanent urban structure.

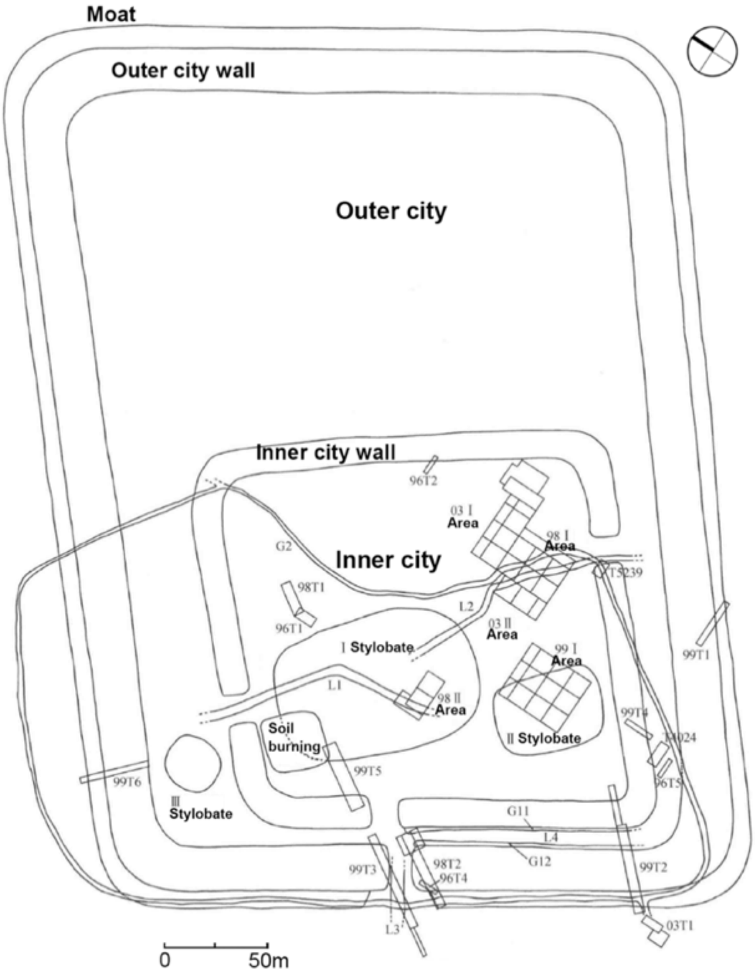


Figure 5.3. Archaeological map of the city Teng 'hua' luo. Resource © (Nanjing Museum, 2014). Translation by the author.

5.1.3 Er'li'tou: with a complete palace CIC within the capital city

There are doubts that the ancient city Er'li'tou 二里头 (case study 2 in Figure 5.1 and 5.2) was the capital city of Xia dynasty because the existence of the dynasty cannot be established with archaeological findings (Allan, 1984, Thorp, 1991). However, the CIC structure appearing in Er'li'tou culture period from around 1900 B.C. to 1500 B.C. (Wu et al., 2016) represents the earliest palace city with complete surrounding walls in Three

Dynasties. The palace city in Er'li'tou has an area of 0.108 km^2 (Zhao, 2006b, Hong Xu, 2004). The existing earliest Chinese bronze tools in Er'li'tou demonstrates the progress of ancient people in lives, productions and wars, which suggests Er'li'tou has a bigger power to influence on a larger surrounding territory than other earlier cities. Moreover, from the archaeological findings inside the inner city, it likely served the ruling elites as a site of state governance and living quarters, which confirms the role of it as a palace city (Xu, 2018, Xu, 2017a, Xu, 2016). The appearance of a palace CIC in Er'li'tou may not only suggest the new urban construction method to meet the needs resulting from a growing population but also further symbolized the spatial segregation of urban spaces led by the social segregation. Before Er'li'tou there had been a city called Tao'si *陶寺* (2300-1900 B.C.), for which only incomplete archaeological remain to determine the possible existence of a palace city for ruling a smaller kingdom. In contrast, the complete palace CIC of Er'li'tou belonged to an early large-territory state. Due to its greater influence on the surrounding regions as well as the use of the earliest bronze ritual vessels, Xu (2018) identified Er'li'tou as the first Chinese capital city of the state with the concept "Central State" *中国*. In Xia, Shang and Zhou dynasties, the central state was more like a political leader of different sub-kingdoms scattered in ancient China. Local self-governance of agriculture production and military defence of each sub-kingdom hindered centralization, which suggests that the governing structure in Three Dynasties for collecting financial resources to support the construction of palace CICs was weaker than that of the later imperial states.

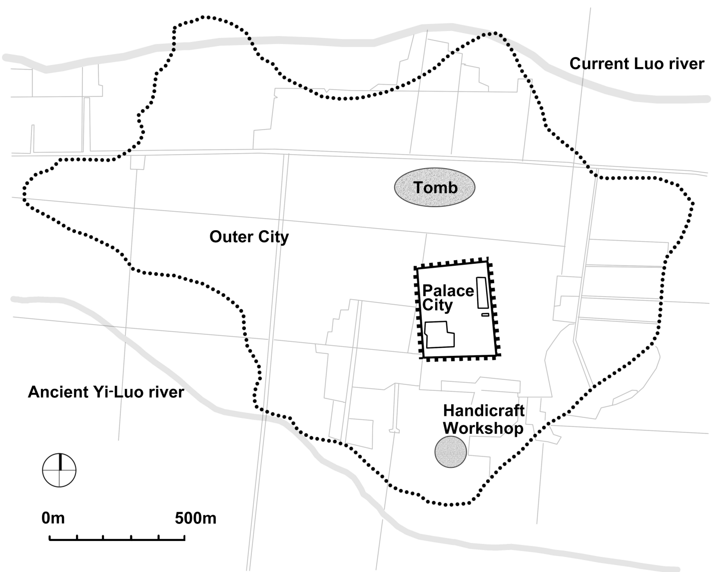


Figure 5.4. The map of archaeological remains of Er'li'tou (case study 2 in Figure 5.1 and 5.2). Figure adapted by the author from (Zhao, 2006b, Xu and Zhao, 2004, Xu, 2018)

5.1.4 Shang cities including Yan'shi in early Shang dynasty

The Shang dynasty (1570-1045 B.C.) built its cities with a large residential population during the warm climatic period and was described as the first Chinese "Central State" by Von Glahn (2016). Three important Shang cities were found in archaeological studies. The Shang city Yan'shi *偃师商城* (case study 3 in Figure 5.1 and 5.2) had about 60 thousand people and the Shang city Zheng' zhou *郑州商城* (case study 4 in Figure 5.1) had about 100 thousand people (Yang, 1992). While the later capital city Yin'xu *殷墟* (Yin Ruins, case study 5 in Figure 5.1) had about a population from 140 thousand to 230 thousand people in different periods (Song, 1994a). The population estimate is based on the low floor area ratio (FAR) due to the large proportion of single-story buildings revealed in archaeological remains[16]. The above studies suggest that the cities with low FAR in Shang dynasty supported a density about 30 thousand people per km^2. Of the above significant cities in Shang dynasty, Yan'shi had the clearest triple city wall structure. The earliest city wall of Yan'shi was the inner wall and the outer walls came later, which suggests the palace and the small city (the inner city) were built first, then the civilian residence construction started to appear around the inner city (Zhang, 2000). The construction process of the capital city reflects the priority of security as well as the social distinction between upper classes (inside) and lower classes (outside). The construction of large outer city walls was also due to the city population growth. Moreover, the existence of barracks and handcraft workshops inside the outer city walls of Yan'shi reflects the city's significant military function (Xu, 2016).

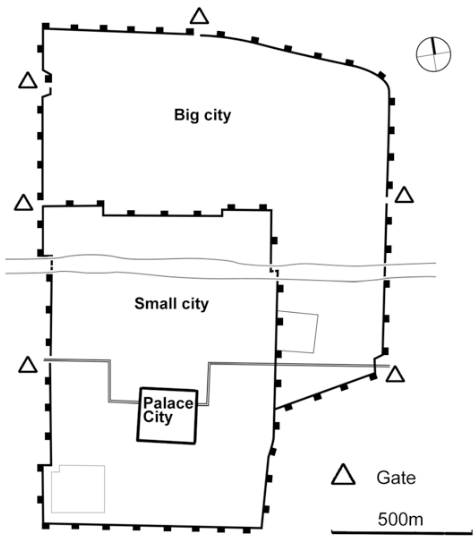


Figure 5.5. The archaeological map of Shang city Yan'shi (case study 3 in Figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Team 2 in Henan from Institute of Archaeology in Chinese Academy of Social Sciences, 1999)

[16] Song Zhenhao (1991) wrote that every household living within Shang city occupied an average area from 150 m^2 to 160 m^2 and on average every household had 5 members. With the specific land area of the archaeological remains, it is possible to estimate the specific population in a Shang city.

5.1.5 The earliest CIC structure depicted on ancient maps as a symbol for Rites of Zhou in city planning

In Western Zhou dynasty (1046-771 B.C.), King Wu of Zhou *周武王* (~1087-1043 B.C.) decided to construct the capital city in Luo'yi *洛邑* (in present day Luoyang) to locate his power in the geographical centre of the state. In Eastern Zhou, two significant capital cities named Cheng'zhou *成周* and Wang'cheng *王城* (King City of Zhou) appeared in the planning history of Chinese capital cities. As shown in the map (Figure 5.6), the ancient scholars in Han and following dynasties tended to classify these two cities into independent cities to the north of Luo river. Similar to two earlier capital cities Feng'jing *丰京* and Hao'jing *镐京* (Figure 5.24) in Western Zhou dynasty, Wang'cheng and Cheng'zhou (Figure 5.26) also constituted a system of two capital cities for maintaining the political and military control of increasing population and territory, though the distance of former two cities was much shorter than that of the latter two cities.

After that, a clearer CIC structure was found in archaeological remains of the King City of Zhou in Eastern Zhou dynasty (Figure 5.8). The palace city in King City of Zhou accounted for 1/9 of the whole areas within the outer city wall while a larger proportion of normal residence houses filled the outer city, which guaranteed that state finance burdened by the peasants would not be exhausted by the construction of the CIC. The Zhou dynasty in China significantly influenced the social relationships as well as the urban planning of capital cities, which were all based on the order of Zhou Li *周礼* (Rites of Zhou). The criteria for how to arrange the urban construction based on Rites of Zhou was clearly described in ancient book called *Kao Gong Ji 考工记* (Figure 5.6) as showed below:

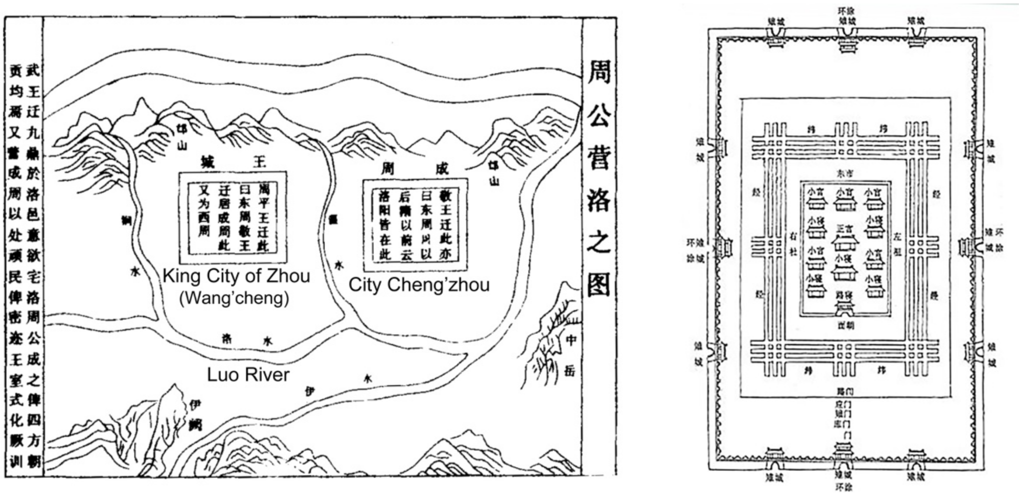
Chinese: "*匠人营国,方九里,旁三门。国中九经九纬,经涂九轨。左祖右社,面朝后市。市朝一夫。*" (Jixia Academy and Wen, 1993).

Translation: When the craftsmen construct the king city, it should be with an area of nine square Li[17], and every side of the square-shaped outer city wall must have three gates. Within the outer city, there are nine roads with north to south direction and another nine roads with west to east direction. Moreover, every road can run nine carriages side by side. The Ancestor Temple is located on the left of the urban centre (palace city) and the Altar of Land and Grain[18] is located on the right. The Ancestor Temple and the Altar of Land and Grain are all situated in front of the royal hall, where the king and his ministers meet up to discuss the state affairs. The royal hall lies in the front and the market to the back of the palace city. The zone including the market and the royal hall occupied the

[17] Li *里* is one of the Chinese measuring units and one Li is 500 meters. Based on the description Kao Gong Ji, the King City of Zhou is about 20.25 km^2.

[18] The centre of a Chinese Altar of Land and Grain is an open square to pray to the gods of earth and harvest. Beside the square there is a temple to worship the gods.

area of one Fu[19].



• Map of the construction of Luo'yi by Duke Zhou (© Luo'yang Fuzhi–洛阳府志)

• Map of King City of Zhou (© Yuan•Henanzhi preserved in Yongle dadian, juan 9561 –元•河南志,永乐大典,卷9561)

Figure 5.6. The map of the construction of Luo'yi by duke Zhou and the map of King City of Zhou

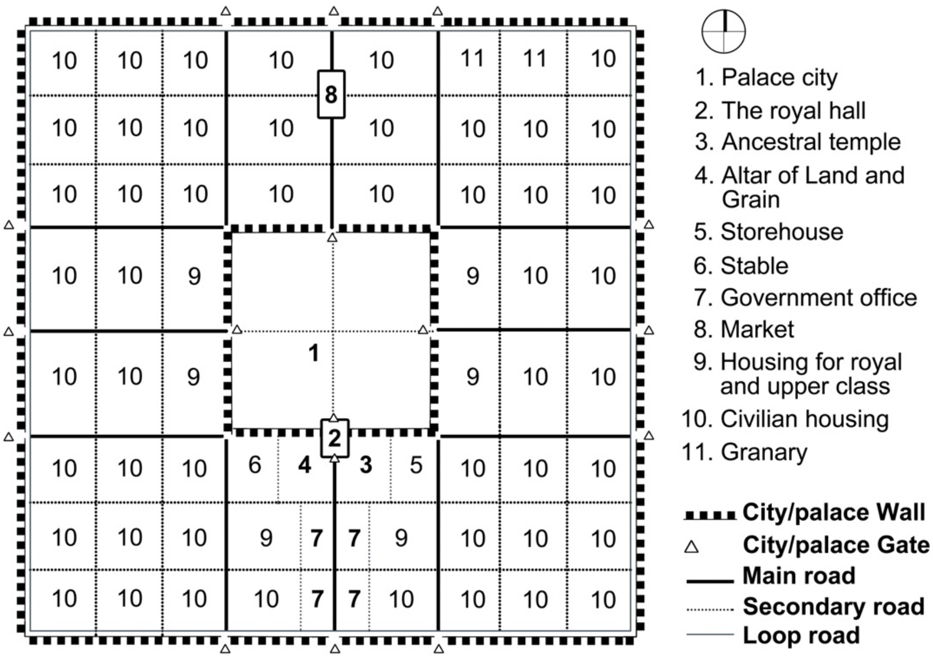


Figure 5.7. Map of King City of Zhou: prototype of ancient Chinese capital cities. Figure adapted by the author from (He Yejv, 1985; Jixia Academy and Wen, 1993)

From a structural analysis of the King City Map of Zhou, the royal hall is closer to the palace city which is also close to the left Altar of Land and Grain as well as the Ancestral Temple on the right. All the buildings mentioned above formed the political and religious

[19] Fu 夫 is a measuring unit of ancient China and one Fu is 100 Mu. Mu 亩 is another ancient measuring unit in China and 15 Mu is about one km^2. Hence, one Fu is about 6.67 km^2.

centre of the country ruled over by the king of Zhou dynasty and his officials. The market is far away in the back of the palace city as described in the ancient book called Kao Gong Ji, which suggests that the market（case study 8 in Figure 5.7）seem to be less important than the hall (case study 2 in Figure 5.7) in front of palace city. However, the maps of King City of Zhou show the urban structure summarized by ancient map painters to reveal the earliest integration of a commercial morphology in a city's planning.

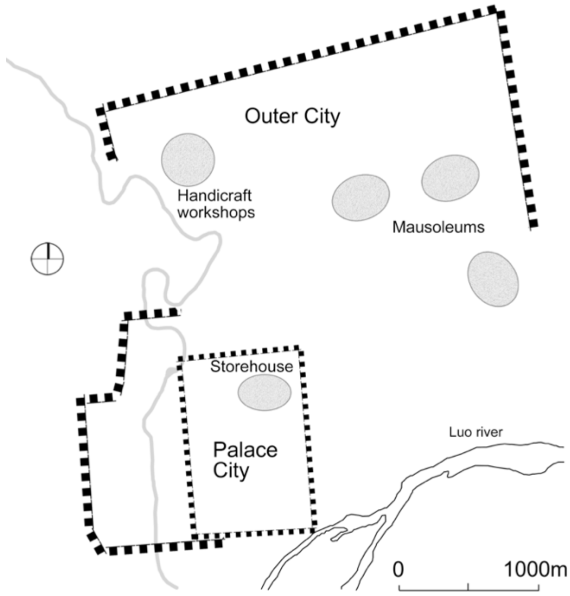


Figure 5.8. The map of archaeological remains of late period King City of Zhou. The single palace structure is clear and the size of the palace city accounts about 1 in 9 of the area of the capital city, which matches the rules in King City Map of Zhou. Figure adapted by the author from (Xu, 2017b, Nie, 2010).

Different versions of the map of King City of Zhou were drawn by individuals in different dynasties after Western Zhou. The planning of King City of Zhou revealed the order emphasized by the ancient Chinese philosophy[20] in the book *I-Ching 易经* (*Book of Change*) written by King Wen of Zhou (1125-1051 B.C.) and annotated by Confucius (551-479 B.C.). In the Map of King City Zhou, the palace city was located in the centre of the capital city as a CIC and around it there were the residence areas, the urban market, governmental agencies, religious areas as well as nearby transportation via roads, which demonstrated that the nobility living in the CIC had the supreme power in leading the state.

[20] In the King City Map of Zhou, the planning of nine zones as well as the central position of palace CIC in the capital city followed the rules in book I-Ching. The central position was symbolized by number 5 in I-Ching. Moreover, each of the 64 gua in I-Ching has 6 Yao *爻* in a row from bottom to top, of which the fifth Yao has a leading position among the six. Each positive Yao (counted with an odd number from bottom to top) is also called Nine (the most positive number 9 = 4+5) and each negative Yao (counted with an even number from bottom to top) is called Six (the most negative number 6= 1+5). So the fifth Yao of the first gua (Qian gua *乾卦*) is also called Nine-Five Yao in Qian gua, which is the leading figure of Qian gua. Moreover, Qian gua symbolizes heaven, dragon, emperor, father as well as other most positive things in ancient Chinese culture. In the King City Map of Zhou, the planning of nine zones as well as the central position of palace CIC in the capital city followed the rules in book I-Ching, which was the core of ideology in Western Zhou and was embedded in the establishment of Rites of Zhou.

5.1.6 Cities with CICs after western Zhou dynasty

• The continuity of CIC structure established in King City of Zhou: the capital city Lu'cheng of the state of Lu and the capital city An'yi of the state of Wei in Eastern Zhou

The state of Lu is the feoff[21] (a sub-kingdom) of Bo Qin *伯禽* (~1068-998 B.C.) who was the eldest son of Zhou Gong Dan *周公旦* (Duke of Zhou, a young brother of King Wu of Zhou. It was Zhou Gong Dan who planned the capital city in Luo' yi and established Rites of Zhou.). In the book *Zuo Zhuan 左传*, the state of Lu is described as a place maintaining the rites of Zhou (Wen, 2012), which would also be key to understanding the influence of Western Zhou dynasty on the construction of the capital city of the state of Lu (Lu'cheng *鲁城,* case study 11 in Figure 5.1). Lu'cheng had the CIC structure (Li, 2009) depicted in the Map of King City of Zhou until Spring and Autumn period[22] (770 – 476 B.C.). In Han dynasty, Lu'cheng shrank and only occupied one south-west part of the original city in Zhou dynasty, but it still remains the CIC structure (as the local ruler's palace city) because Han dynasty preserved part of the feoff system and Lu'cheng became the regional capital city ruled by a son of the emperor in Western Han dynasty. However, the increasingly centralized governance also weakened the strength of local elites as well as reduced the size of their city zones within and outside of CICs. In Qing dynasty, the city area of Lu shrank so significantly that it almost lost its CIC structure.

Lu'cheng was built in Western Zhou and existed for 700 years in Zhou dynasty (Xu, 2000) according to the records in *Zuo Zhuan 左传* and *Shi Ji 史记*. This city had walls built by different dynasties according to archaeological findings. The biggest outer city wall belonged to the Spring and Autumn period as well as the Warring States period in Eastern Zhou dynasty. The palace city in the middle was also the CIC for the capital city. In Figure 5.9, the palace city is close to the urban centre and Lu'cheng had a similar urban structure to that in the map of King City of Zhou. In ancient China, following the rules in King City Map of Zhou to construct capital cities was continued by the imperial members who respected *Zhou Li* (Rites of Zhou). Moreover, Xu (2017a) argues that the Palace city of Lu'cheng in Warring states period and the outer city Lu in Han dynasty utilized the same part of city wall (Figure 5.9 and 5.10). Those capital cities in Warring States period always built palace cities (large city in Figure 5.10) with large-scale walls, which suggests a sound financial situation supports the city construction in Warring States period.

---

[21] In Zhou dynasty, the ruling classes developed a feoff system to control the large territory of the country. In this system, the King of Zhou only controlled a central territory and the surrounding territories would be divided and feoffed to the kings of sub-kingdoms. The kings for each feoff land should be loyal to the King of Zhou dynasty, who was also worshiped as the son of heaven.

[22] Eastern Zhou dynasty (770-256B.C.) is constituted by Spring and Autumn period (770 – 476 B.C.) and Warrior States period (475 – 256 B.C.).

In Figure 5.10, the city size of Lu'cheng in Han dynasty became much smaller than before due to the centralization in capital city Chang'an and only kept the area of the middle and southwest part of the area in Eastern Zhou. In Han dynasty, the palace area was still located within the city though now in the north-east of the city. The king of Lu in Han dynasty lived as a Duke in ruling Lu'cheng. The shrinking of the regional capital city Lu was because powers were removed from Lu. Even though Lu'cheng in Zhou and Han dynasties kept the CIC structure, the shrinking of the urban area did not stop. In Qing dynasty, the city area of Lu'cheng (called Qu'fu *曲阜 in Qing dynasty*) was reduced to a smaller size. The function of original palace city, which had been in the periphery area outside the city wall, changed that of the temple of Zhou Gong *周公* (Duke of Zhou, the fourth son of King Wen of Zhou). The new centre area of Qu'fu in Qing dynasty became a significant temple to worship Confucius in China. From the perspective of a span of over 2000 years, the regional function as a political centre surpassed the religious influence of Confucianism with regard to the urban scale and CIC structure in dynasties after Qin.

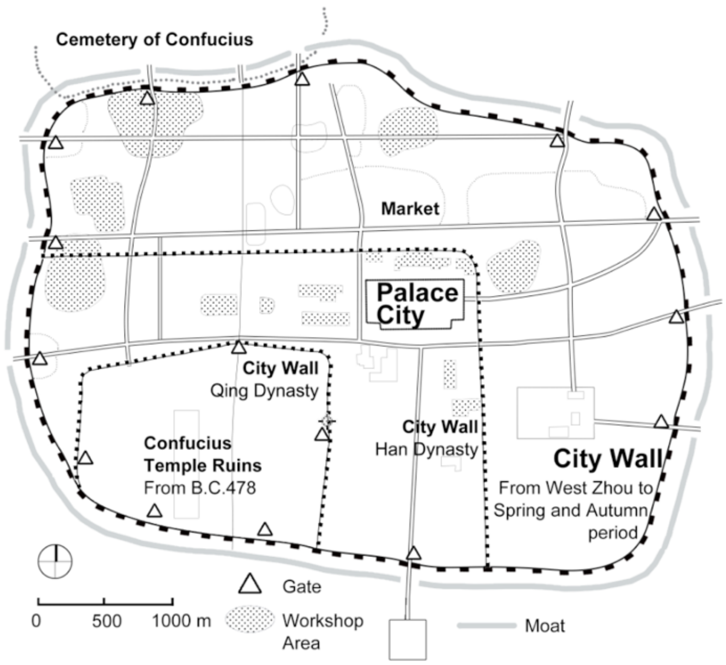


Figure 5.9. Capital city of Lu'cheng *鲁城* (Case study 11 in Figure 5.1 and 5.2). From Western Zhou to spring and autumn period in Eastern Zhou. Figure adapted from (Wang, 2005, Xu, 2016).

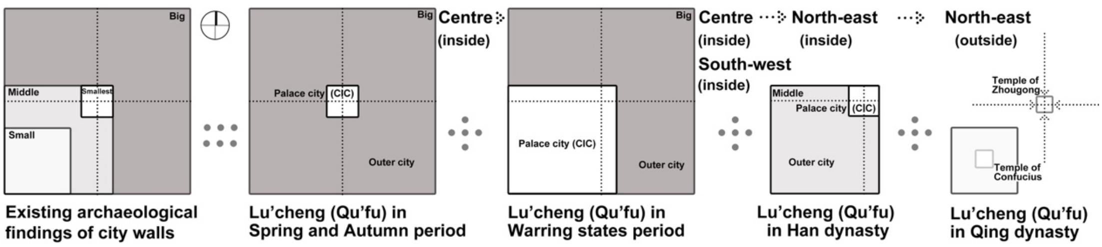


Figure 5.10. The city structure changes and the CIC locations in urban area of Qu'fu in Zhou, Han and Qing dynasties. Figure drawn by the author.

However, the commercial functions were far from shaping the structure of Zhou dynasty CICs, which were mainly designed for state governance and security defence. The market area and the other handicraft workshops were not even located close to the palace city as the royal hall and temples were, as depicted in the map of King City of Zhou. Because we cannot be certain whether the market outside the palace serve the people who live inside that CIC, further analysis based on the archaeological findings and historical literatures must be conducted.

Similar to the remains of Lu'cheng (capital of The state of Lu in Spring and Autumn period), the remains of ancient city An'yi (capital of The state of Wei in Warring States period) has a triple city wall structure demarcating the big city, middle city and small (palace) city (Tao and Ye, 1962). The small city, as the palace city, and the big city were probably constructed during the same time in Warring States period. The middle city was built in Han dynasty (Shanxi Provincial Institute of Archaeology, 2005). The small city was used for the longest time from the Warring States period (475-221B.C.) to Han dynasty.

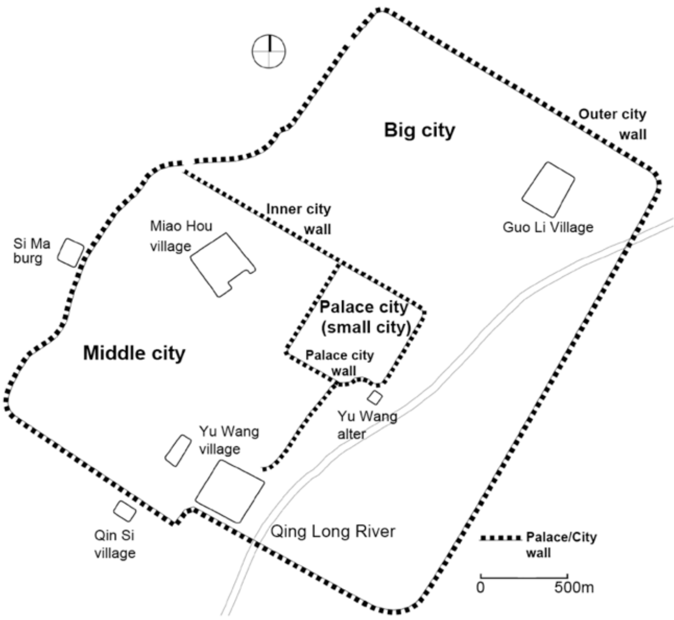


Figure 5.11. An'yi 安邑 (case study 12 in figure 5.1 and 5.2) The capital city of Wei in Warring States period of Eastern Zhou Figure adapted from (Institute of Archaeology Chinese Academy of Social Sciences, 2004)

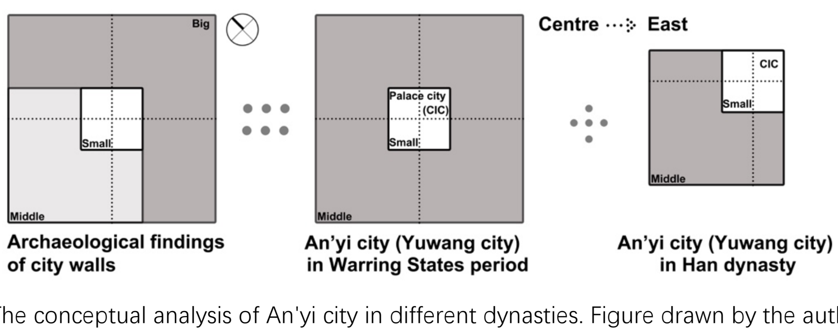


Figure 5.12. The conceptual analysis of An'yi city in different dynasties. Figure drawn by the author.

From this case study, for the second time in this dissertation we come cross the remains of triple city walls built in different periods. An'yi was the capital city of Wei from 562 B.C. to 362 B.C. An'yi functioned as the capital city for the strongest Wei state at the beginning of Warring States period, which made Anyi an important city in geo-political affairs during that time. However, the king of the state of Wei decided to move the capital city close to the geographical centre of warring states as a central leader, rather than focusing on expanding the territory or increasing the population as done by the state of Qin. Accordingly, since the king did not increase the state strength, moving the capital city to Da'liang marginalized the An'yi. Moreover, Wei was trapped in endless wars with the surroundings from all directions. In Han dynasty, An'yi shrank significantly yet still kept the CIC in the northeast of the outer city.

Few of the cities in Eastern Zhou dynasty followed the planning of King City of Zhou. A thinker named Guan Zhong *管仲* (725-645 B.C.) in the state of Qi *齐国* proposed a new planning theory which became dominant due to it was adapt to the demand of constructing capital cities with a high efficiency in war periods. Guan Zhong proclaimed that city construction should be based on the objective geographical situations including landform and hydrological regime to meet the actual requirements and not follow the rigid planning rules employed in capital cities of Western Zhou dynasty. This theory also stimulated the subversive power in urban planning of Qin and Han dynasties to develop multi-palace structure in capital cities, contrasting to the single central palace city in capital cities of Western Zhou.

• **The capital city Xian'yang in Qin dynasty**

Qin dynasty was the first Chinese empire to implement the governance system of prefectures and counties (Junxian system in table 2.1), which strengthened and stabilized the centralization of emperor. Hence, the resources of the unified state were collected to build the capital city Xian'yang *咸阳* (case study 13 in Figure 5.1, 5.2, 5.24). Moreover, Emperor Ying Zheng *嬴政* (259-210 B.C.) forced wealthy people and craftsmen in the defeated states to migrate to Xian'yang. At the same time, Ying Zheng promoted the construction of the Great Wall, which was seen as a strong guarantee of the territorial security for the whole empire. This may also have been why no outer city walls surrounded the capital city during Qin dynasty (Xu, 2017a).

In current archaeological findings, the capital city of Qin dynasty did not have a specific outer wall structure but constructed about 13 large palace CICs, including Xian Yang palace *咸阳宫*, Xing Le palace *兴乐宫* and E' pang palace *阿房宫* etc. (case study 13 in Figure 5.1 and 5.2), which were scattered within the capital area (Quan et al., 2018). These palace cities were not arranged along clear urban axes or located close to urban centres. In fact, the construction of Xian'yang had not only broken through the institutional limitations imposed by King City of Zhou, but also implemented Guan Zhong's planning theory in an extreme manner. The population and financial growth, as well as the emperor's superstitious belief in the necessity of arranging placement of each palace in relationship with the others by imitating the stars' relationship were direct reasons for the urban expansion.

Figure 5.13. The map of the territory for Qin dynasty. Figure adapted by the author from (Guo, 2017)

• The city Chang'an in Han dynasty

After the first Chinese empire, Qin, fell, the multi-CIC structure of the palaces developed during the dynasty did not disappear in the burning of Xian'yang. The Han dynasty founded later constructed its capital city Chang'an on the palace ruins of Xian'yang. The palace city, Chang Le *长乐宫* in Chang'an was constructed on the basis of Xing Le palace *兴乐宫* of Xian'yang (Figure 5.14 and 5.24). The ancient Chinese astronomer and litterateur Zhang Heng (78-139 A.D.) in Eastern Han described Chang'an of Western Han by comparing it with capital cities in Zhou and Qin dynasties. " Chang'an in Western Han dynasty included the urban structure of Xian'yang in Qin dynasty but transcended the planning rules of King City of Zhou"[23], which suggests that the capital cities (Xian'yang in Qin dynasty and Chang'an in Han dynasty) represented a revolt against the urban planning system established in Zhou dynasty. However, the capital city Chang'an of Western Han constructed the outer city walls, which was different from Xian'yang in Qin dynasty.

[23] *张衡. 西京赋（English name: The pome of western capital Chang'an）*,"*览秦制，跨周法*". In this satire pome, Zhang Heng criticized the social extravagance of Chang'an in Western Han dynasty.

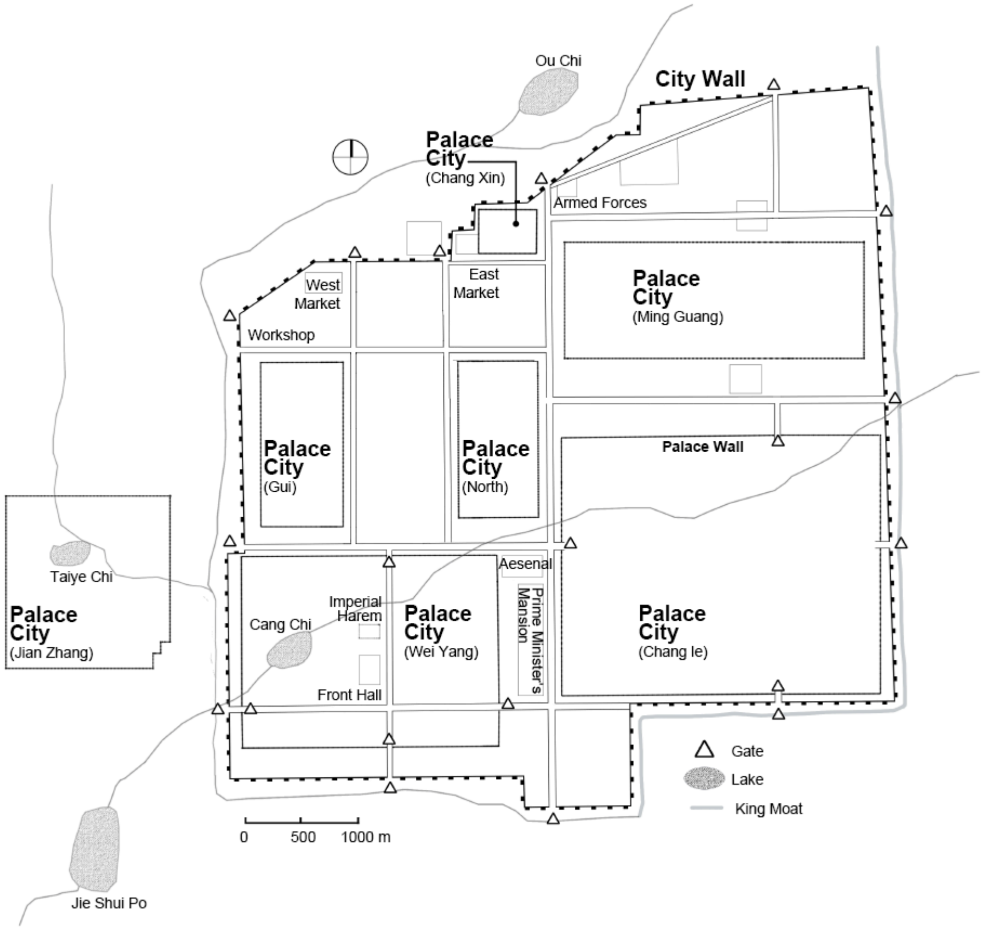


Figure 5.14. Chang'an 长安, capital of Western Han dynasty (case study 14 in Figure 5.1 and 5.2). Figure adapted from (Cheng and Hsu, 1980) by GU Yan and LI Chenghui.

Comparing the social backgrounds of Zhou, Qin and Western Han dynasties, the military defence problem becomes a significant consideration for the urban construction in Han dynasty. In Zhou dynasty, the King City of Zhou was located in an area inhabited by the Shang people. The threat of the resistance from local Shang people as well as an invasion by north-west nomad people led to the construction of palace city walls and outer city walls to improve military security. Before the state of Qin became the Qin empire from Warring States period to Qin dynasty, it had overcome the barbarians in the north and west. Moreover, the construction of Great Wall during Qin dynasty also enhanced the security of the imperial territory. Even though the scattered palace cities in Han dynasty put an end to the concentric structure with a single palace on a symmetrical axe developed in Zhou dynasty, these palace CICs were still located within an outer city wall because of the threat from the invading north-west Huns. Chang'an (Figure 5.14) in West Han dynasty acted as the major capital city, with six palace cities inside the outer city wall and only one palace city Jian Zhang 建章宫 located outside. When Jian Zhang palace was constructed by emperor Han Wu 汉武帝 (156-87 B.C.) in 104 B.C., the north-west Huns had suffered bitter defeat in the wars against Han Wu's military.

However, no matter how the capital cities were transformed from Zhou dynasty to Han dynasty, their palace cities always retained CIC structures. Those palace CICs supported the upper social classes including royal members, government officers and their servants in their daily lives and duties. The CIC wall functioned here as a spatial segregation for different social classes as well as guaranteeing safety. The population inside the outer city walls of Chang'an was about 250,000 people as shown by the household registration recorded in *Han Book: Geography 汉书·地理志*. An analysis of the archaeological map in figure 5.14 shows that the CICs occupied more than half of the city area, which might reflect a crowded public life. To confront the population growth and the scarcity of the outer city space for normal citizens because half of the capital city Chang'an were occupied by palace CICs, 5 large royal mausoleum fiefdoms were built on the north of Wei river and another 2 large royal mausoleum fiefdoms to the southeast of Chang'an city. These mausoleum fiefdoms functioned as the satellite cities around Chang'an city to accommodate large populations (Xu, 2009b). The 7 royal mausoleum fiefdoms locating around the capital Chang'an also strengthened the military defence of Chang'an.

Two ancient Chinese paintings in Song and Ming dynasties depict the ancient royal life in Eastern Han dynasty, within Han palace walls. In the palace illustrated in Figure 5.15, there were a few people inside the palace city. The Gan Quan palace *甘泉宫* in this painting was a detached palace, outside the outer city of Chang'an, a summer resort for many significant events. This palace was built on the ruins of Lin Guang palace *林光宫* in Qin dynasty. In the second painting, more people are depicted and the royal life within the walls appears luxury and colourful (Figure 5.16). The subjective depiction/expression in the paintings by artists in Song dynasty and Ming dynasty must be influenced by their own experiences within different social backgrounds. The warm weather and population concentration in the capitals city of Southern Song dynasty might have influenced the Song painter to create a quiet and secluded atmosphere. In contrast, the cold and drought weather in Ming dynasty bitterly struck the agriculture production and slowed the population growth, which may have inspired a warm and lively scene in the painting by Ming painters.

However, in the Song masterpiece and the one painted in Ming dynasty, the walls and gates are located on the right in the pictures, which, based on the ancient reading habit from right to left, suggest the starting point in the spatial logic of palace cities. Together with the collective lifestyle, the enclosures and gates were always necessary attributes defining palace CICs in ancient China.

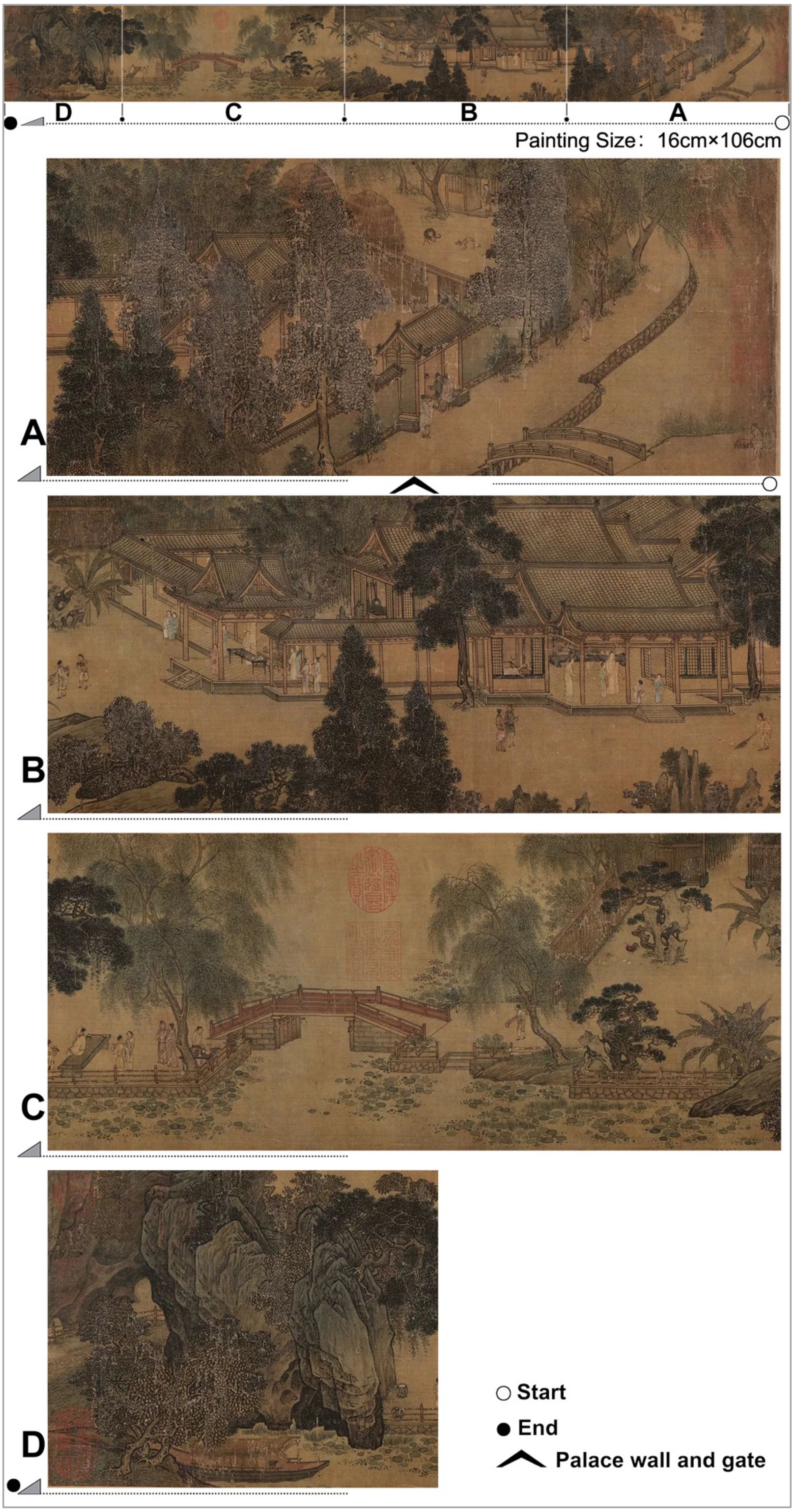


Figure 5.15. Autumn in Han palace（*汉宫秋图* Han Gong Qiu Tu）, traditional Chinese realistic painting by an anonymous painter in South Song dynasty. Painted between 1127 A.D.-1279 A.D.

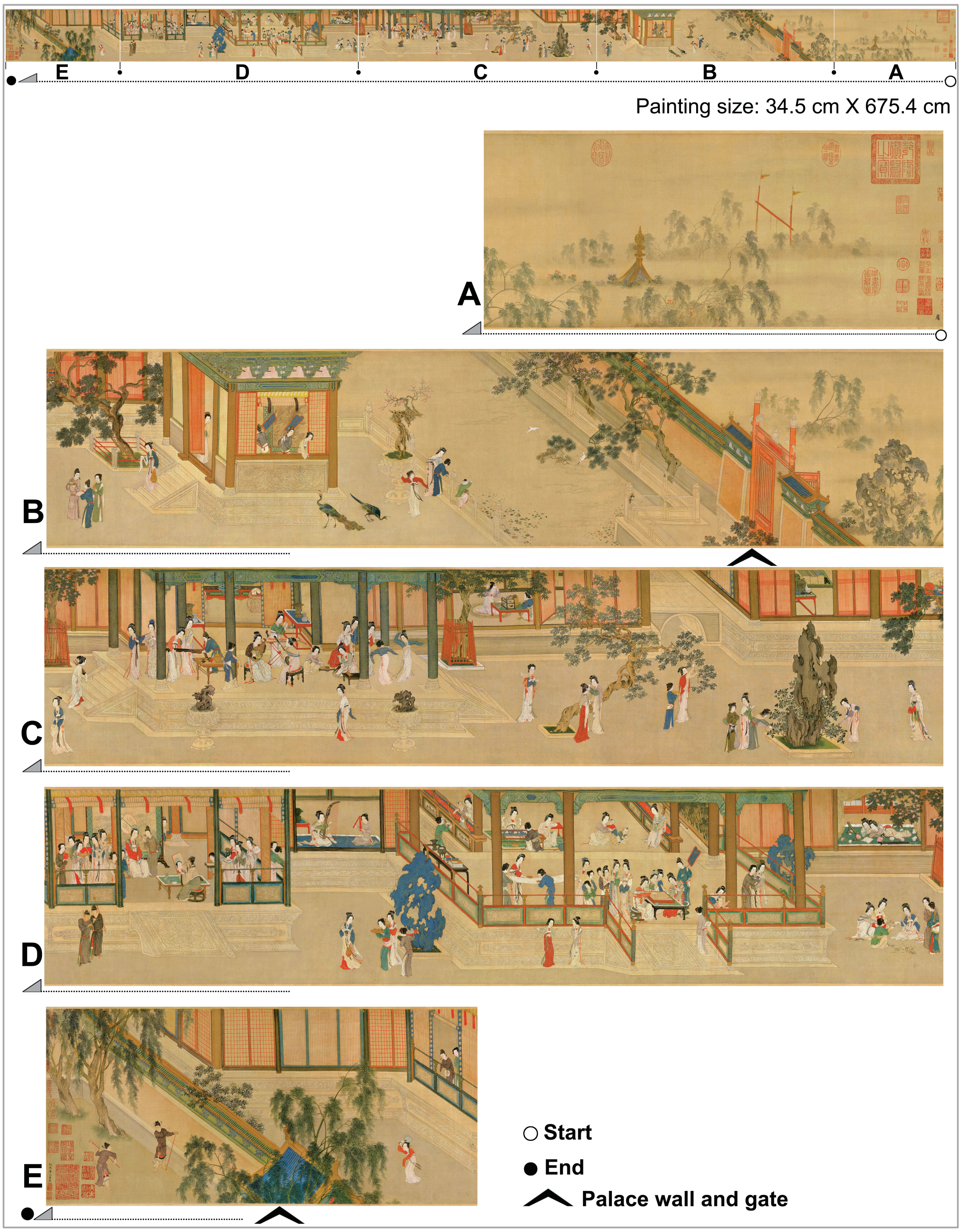


Figure 5.16. Spring morning in the Han palace（*汉宫春晓图* Han Gong Chun Xiao Tu）, traditional Chinese realistic painting drawn by Qiu Ying *仇英* in Ming dynasty. Painted between 1540-1544 AD.

Because of the large proportion of palace cities within the capital city Chang'an, Yang (1993) wrote that the outer city of Chang'an functioned more like a greater inner city surrounded by those royal mausoleum fiefdoms. These palaces within the outer city walls were a cluster of palace CICs defended by a same outer city wall. The warm and wet weather in Warring States period and the following Qin and West Han dynasties contributed to the agricultural production. The stable agriculture production created a solid economic foundation for the establishment of centralized political system in Qin and Western Han dynasties. Accordingly, it is possible to understand why the growth of CIC size and the increase in the number stagnated in the cold and drought period which followed in Western Han dynasty. In particular, the capital city Luo'yang in Eastern Han is a good example to explain the later changes on CIC planning resulting from the cold and drought period.

• The city Luo'yang in Eastern Han dynasty

Another cold and drought period began in late Western Han, which was then conquered by the Xin dynasty that only lasted 15 years. Eastern Han dynasty, which followed, established its capital city in Luo'yang expanding on the heritage left by Qin and Western Han. In Figure 5.17, only two big palace cities lie within the capital city, which suggests that the construction of the capital city in Eastern Han was more frugal than that in Western Han.

The first emperor of Western Han named Liu Bang *刘邦* (256-195 B.C.) initially intended to locate the capital city in Luo'yang, but accepted the proposals from his ministers to build the capital city in Chang'an[24], which was close to the capital cities of Qin and Western Zhou (see Figure 5.24). There had been two palaces in city Luo'yang during Qin and West Han (Yang, 1993). The prime minister Lv Buwei *吕不韦* (292-235 B.C.) of Qin empire expanded the city construction in Luo'yang as the local administrative capital city of his fiefdom (Archaeological Team of No. 1A focusing on remains of Luoyang city between Han and Wei dynasties, 1998). However, the city expanded by Lv Buwei could not be compared to the huge capital city in Xian'yang where the emperor Ying Zheng had greater centralized power to gather the resources from the entire state. Though there was a disparity in urban scale and the number of CICs in these two cities, Luo'yang in Qin and Han dynasty still had two independent CICs. The urban construction of the capital cities in Western Han and Eastern Han were based on the urban construction of Xian'yang and Luo'yang in Qin dynasty. For this reason, the capital city in Luo'yang in Eastern Han was smaller and simpler than Chang'an in Western Han. The civil war from Western Han to Eastern Han also weakened the capability of the central government to construct capital cities. As the leader of a new dynasty based on the support of old aristocratic elites, the first emperor Liu Xiu *刘秀* (5 B.C.-57 A.D.) of Eastern Han preferred to implement mollifying policies to govern the state. Compared to Western Han, the weaker central

---

[24] Recorded in Shi Ji *史记·刘敬叔孙通列传第三十九* written by Si Maqian *司马迁*,·Lou Jing *娄敬* told Liu Bang that compared to Chang'an, even thouh Luo'yang located in the centre of the state, it was easier to be attacked but harder to be defended. In well-developed peaceful period, the people appreciated the mercy of central government, which guaranteed the security of capital Luo'yang "*有德则易以王，无德则易以亡*". In contrast, during the war time in chaos, Chang'an became the expedient and strategic location to control the state "*搤天下之亢而拊其背也*", so Chang'an should be selected as the capital city to found the Han empire due to the unstable social environment in the beginning.

government of Eastern Han had to be more cautious in handling the administrative relations between central and local governance. Moreover, during Eastern Han, the deterioration of agricultural production due to the cold and drought period between 65 B.C. and 600 A.D. exacerbated the social famine and chaos, which further reduced the ability of Eastern Han to expand the capital city as well as the palace CICs.

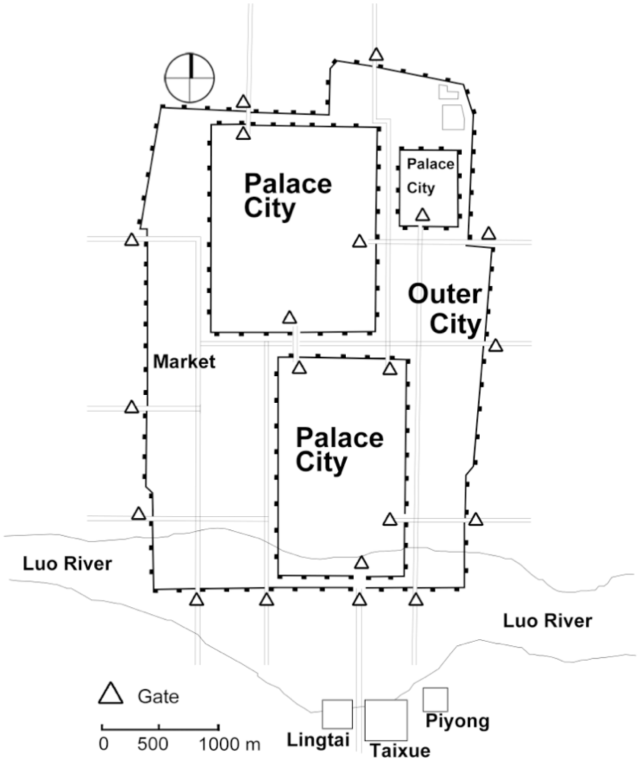


Figure 5.17. The capital city Luo'yang *洛阳* in Eastern Han dynasty (case study 10 in Figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Qian, 2002).

• The capital city Ye'cheng of state Cao Wei in Three Kingdoms period

In the late East Han dynasty, the social chaos caused by the wars between three kingdoms divided and weakened the empire. The wars lasted for about 60 years until the state Cao Wei defeated the other two opponents. During the Three Kingdoms period (220-280 A.D.), plans for the construction of any capital city had to consider the extent of the local people's burden and the limited finances. Hence, the capital cities of these three kingdoms were characterized by the single concentric CIC structure, which returned urban planning to the mechanisms developed in King City of Zhou.

Cao Cao *曹操* (155- 220 A.D.), the founder of state Cao Wei, built the city Ye'cheng *邺城* to the north of the city Xu'chang *许昌* (also named Xu'du *许都*), where he confined the last emperor of Eastern Han. Luo'yang had been burned by other rebels and could not be built in a short time. Xu'chang was close to the geographical centre of the three kingdoms and developed with mature infrastructures, which made it more a symbolic capital. After that, based in Ye'cheng, Cao Cao controlled the central plains region by implementing the Tun Tian system (see Table 2.1), a state-promoted policy on land distribution to normal soldiers and farmers to stabilize and increase agriculture production. By having the peasants, refugees and locally-garrisoned troops farm on the assigned uncultivated land with financial support, the state would guarantee the stable accumulation of harvest. This agriculture policy played a significant role in resolving the shortage of resources in the cold and drought period as well as in wartime.

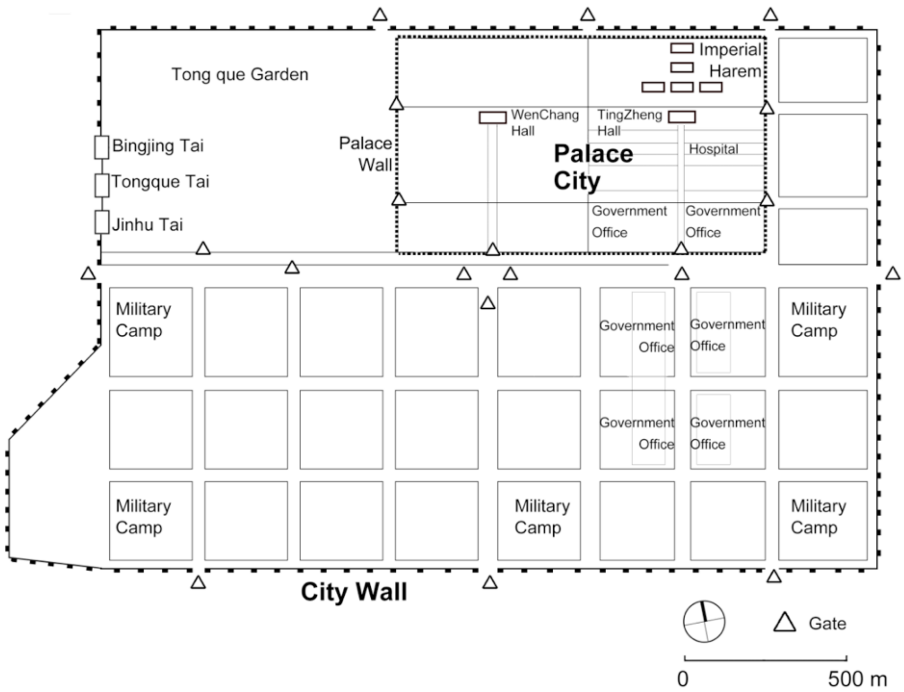


Figure 5.18. Ye'cheng *邺城* Capital of Cao Wei in Three-Kingdom Period of late Eastern Han (case study 15 in Figure 5.1 and 5.2). Figure adapted by GU Yan and LI Cheng-Hui from (Wang, 2005, Qian, 2016).

The government had to quickly organize the citizens' housing and production without any waste due to the harsh weather and cruel wars. Though with a successful agriculture policy, the construction of the capital city Ye'cheng was limited in size. In Figure 5.18, the single palace city as well as the grid road system were closer to the order established in King City of Zhou. Moreover, the legitimacy of the governance in ancient Chinese society was also based on imitating the rites reflected in city planning of Zhou dynasty[25]. To some extent, the planning of Ye'cheng created a balance between the city function and the institutional legitimacy, a practice that also influenced the reconstruction of Luo'yang as the capital city of Cao Wei.

[25] Due to the praise of Zhou Li (Rites of Zhou) by Confucius and the worship of Confucianism starting with emperor Han Wu, the urban planning system of Western Zhou became a symbol of legitimacy for ruling classes after Han dynasty.

• The city Luo'yang in Cao Wei and Jin dynasties

When the city Luo'yang became the capital city again in the state of Cao Wei in 220 A.D., only one palace CIC was located in the centre of the capital city, which made the urban structure just like that of the King City of Zhou. The mutual influences between Ye'cheng and Luo'yang would appeared in the later dynasties before Sui and Tang dynasties, which also lay the foundation for the urban structure employed by later dynasties in China.

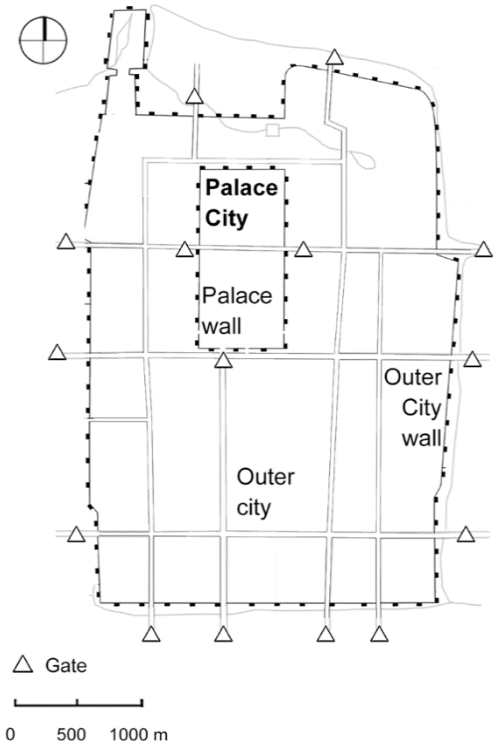


Figure 5.19. Luo'yang 洛阳 in Cao Wei (case study 10 in figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Qian, 2002, Nie and Cheng, 2017).

• The city Luo'yang in Northern Wei dynasty

During the cold and drought period from 65 B.C. to 600 AD. in China, especially between Jin dynasty and Sui dynasty (265—581 A.D.), approximately 25 states waged war against each other. A huge power of the north nomadic regime reunified north China and founded the Northern Wei dynasty which existed from 386 A.D.to 534 A.D. Since he was deeply influenced by the Confucian school, the emperor Xiaowen 孝文 (467-499 A.D.) decided to move the capital city from Ping'cheng 平城 (in the area of present day Datong) to Luo'yang, which first established the triple city wall structure (Figure 5.20) in the city planning history of ancient China. Moreover, the outer city in Cao Wei and Jin dynasties became the inner city of the capital in Northern Wei. For the first time, the CIC of the inner city harbored mixed social classes. The huge outer city did not have walls as high as those of the inner city and the palace city. The grid road system of the outer city was adapted from capital city Ye'cheng of Cao Wei as well as the earlier King City of Zhou.

The construction of a new wall, which made 'the outer city' and 'inner city', in capital Northern Wei was due to the failure of the original city to accommodate the large-scale immigration. The triple city wall system was developed to govern the city with a multi-ethnic integration. After the development and transformation that took place during several dynasties, the city Luo'yang had an increasingly larger proportion of residence areas for the normal citizens (Figure 5.21).

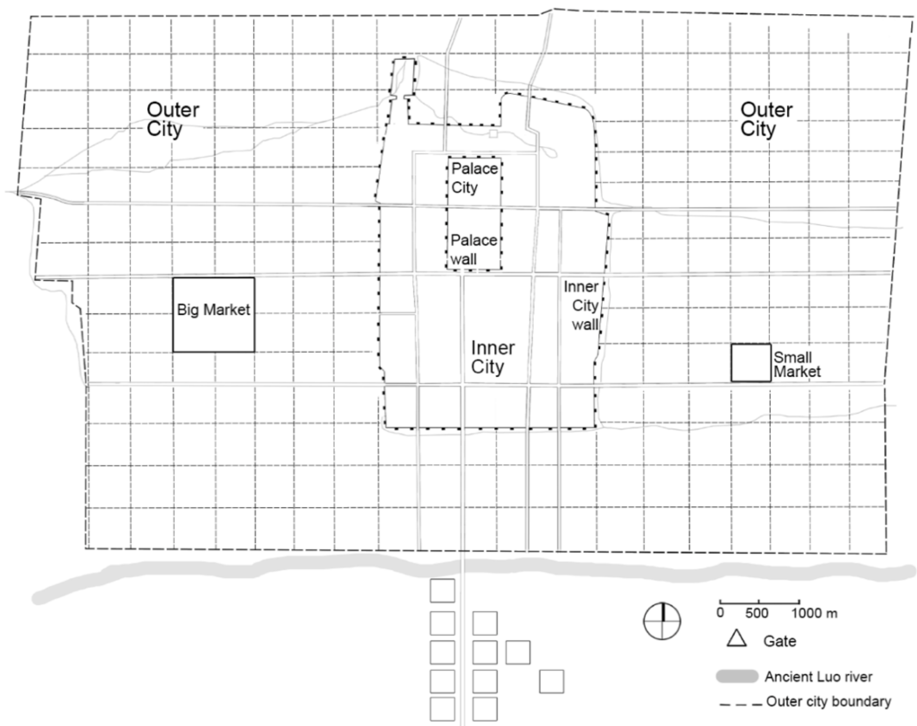


Figure 5.20. City Luo'yang in Northern Wei dynasty. Figure adapted by GU Yan and LI Chenghui from (Zhou, 2018).

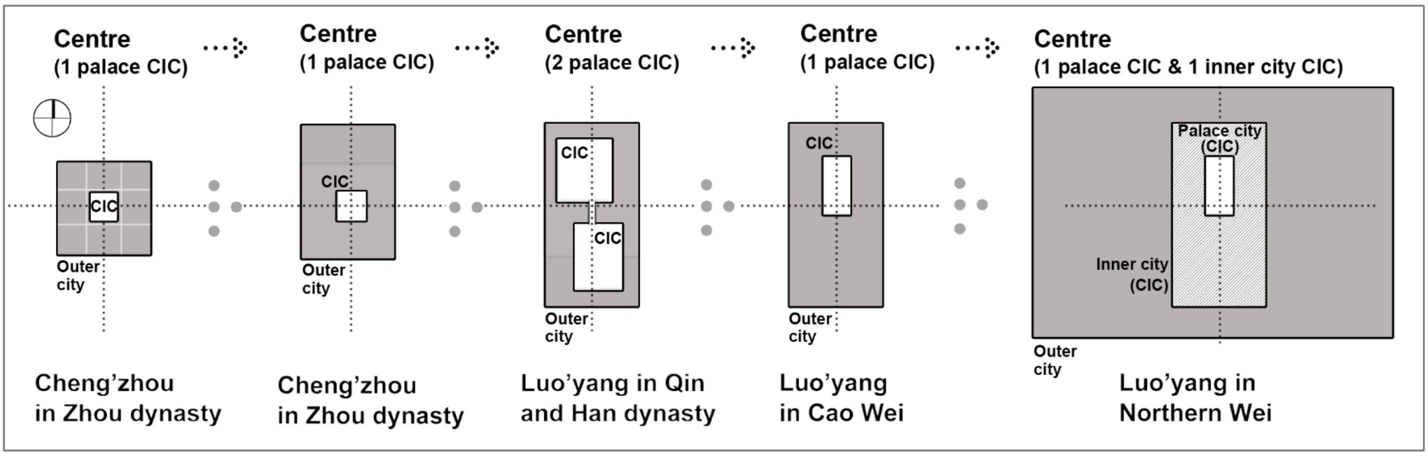


Figure 5.21. The overlaid capital cities of different dynasties in Luo'yang (case study 10 in Figure 5.1 and 5.2). The locations of these city remains overlap each other. Figure drawn by the author.

• **The Ye'nan'cheng in Eastern Wei and Northern Qi dynasties**

In 534 A.D., the Northern Wei dynasty was broken up into two states named Western Wei *西魏* and Eastern Wei *东魏*. Western Wei located its new capital in Chang'an, while Eastern Wei burned the old capital city Luo'yang and established a new capital in Ye'cheng *邺城*. Later, Northern Qi *北齐* replaced Eastern Wei and expanded the territory of Ye'cheng by adding a larger southern part, which led to the establishment of Ye'nan'chen *邺南城*. The archaeological remains revealed that the construction of Ye'nan'chen (Figure 5.22) imitated the urban structures of single palace and triple walls in capital city Luo'yang in Northern Wei (Xu, 2002, Qian, 2016). To some extent, the concentric structure of city walls and single palace CIC in Ye'nan'cheng and Luo'yang follow the planning rules in King City Map of Zhou.

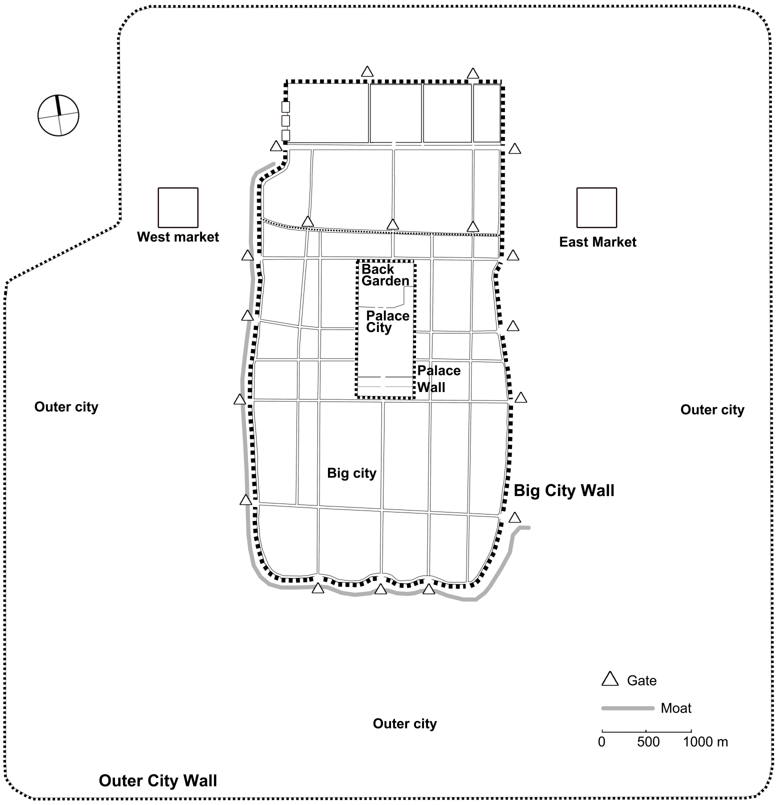


Figure 5.22. The archaeological map of Ye'nan'cheng *邺南城*. Figure adapted by the author from (Xu, 2002, Qian, 2016).

• **The city Chang'an in Sui and Tang dynasties**

Western Wei *西魏* was later replaced by Northern Zhou *北周*. The two states all set their capital cities on the northeast ruins of the capital city Chang'an of Western Han dynasty. When the authorities of Northern Zhou unified the north and south China, which suggested a new era, Emperor Wen of Sui dynasty *隋文帝* (541-604 A.D.) ended Northern Zhou and started the construction of a new capital city named Da'xing *大兴*. The aristocratic descendant from Northern Zhou, named Yu Wenkai *宇文恺* (555-612

A.D.), was responsible for the planning and construction of the new capital city. Because of the wars and the deterioration of living quarters, the dilapidated infrastructure of capital city Chang'an built in Western Han failed to meet the new demand of the Sui dynasty. The threat to Chang'an city in Western Han of flooding from the Wei river 渭河 was also considered by the planners in Sui and Tang dynasties (Yin and Huang, 2008). A new capital city was built southeast of old capital city in Western Han. The Sui dynasty only lasted for 38 years but the new capital city with its name (Chang’ an) was completely preserved by Tang dynasty.

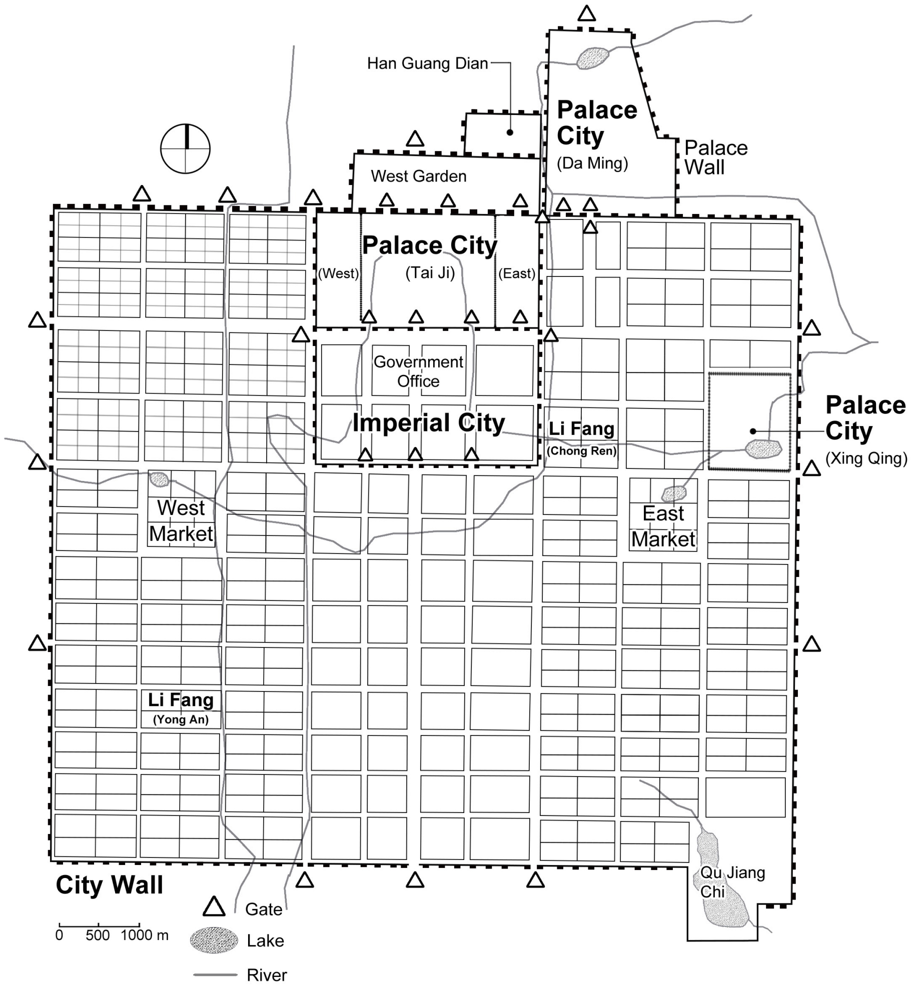


Figure 5.23. Chang'an, capital of Tang dynasty (case study 16 in Figure 5.1 and 5.2). The palace cities, gardens and imperial city were connected as one CIC. Figure adapted by GU Yan and LI Chenghui from (Tatsuhiko, 1994).

The cold and dry period came to an end in China before 600 A.D., Chang'an (case study 16, see Figure 5.23) had a splendid urban planning, in which the planner preserved the single CIC integrating the palaces and government premises in the north centre of the city Chang'an. The CIC (including Tai Ji palace, East palace, West palace and Imperial city) constructed in Sui dynasty occupied about 1/9 of the city area, which was also a prominent attribute of King City of Zhou (Wang, 2009). While the location of the CIC in Tang Chang'an, together with its orthogonal grid road system and Li Fang units (Figure

5.23) in outer city, followed the rules employed by Ye'cheng in Cao Wei and Luo'yang in Northern Wei. Based on an analysis of Table 5.2, the residence population densities in that CIC (11,130-35,047 people/km^2) are lower than those in Li Fang system (4,807-5,333 people/km^2).

	TYPE	*NAME*	*AREA(KM^2)*	*POPULATION (PEOPLE)*
CIC	Palace city	Tai Ji palace West palace East palace	4.2	**Emperor, Queen, concubines and their children:** 200 (residence/ruling) **Eunuchs:** 3,000-10,000 (work/residence) **Maids:** 30,000 (work/residence) **North army:** 7,000-15,000 (work/residence)
		Da Ming palace	3.11	
		Han Guang Dian	0.4	
		West inner garden	1.7	
		Xing Qing palace	1.34	
	Imperial city	Imperial city	5.2	**Central government officers:** 40,000-60,000 (work) **Servers and guardians:** 5,000 (work/residence) **South garrison:** 20,000 (work/residence)
LI FANG (EXAMPLE)	Gated Enclosure	Chong Ren	0.856	**Residents:** 30,000
		Yong An	0.593	**Residents:** 6,600

Table 5.2. The size and population of the palace-imperial CIC in capital Chang'an of Tang dynasty. Table drawn by the author based on (Wang, 1999a, Tatsuhiko, 1994).

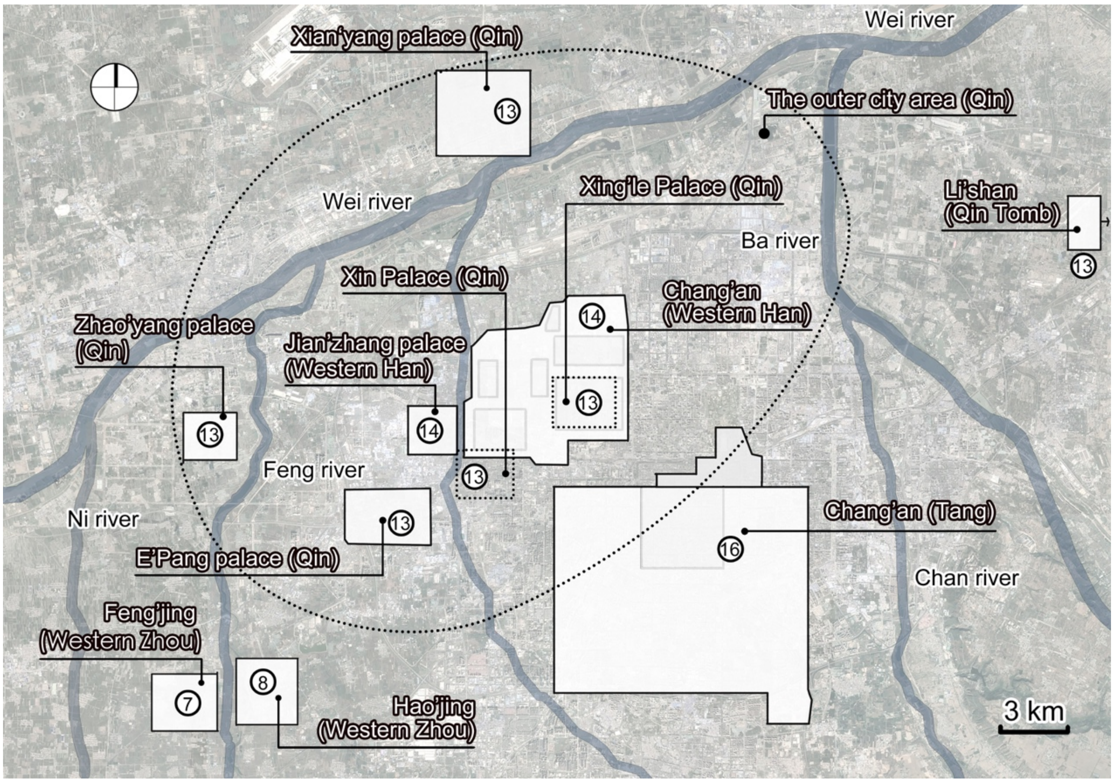


Figure 5.24. The capital cities which were built during different dynasties in Xian'yang and Chang'an area. Figure drawn by the author.

In Figure 5.24, the locations of remains of ancient capital cities in different dynasties are very close or even overlapping each other in the region of Xian'yang and Chang'an (megacity Xian in present day China). The size of the outer city wall for the capital in Tang dynasty was much larger than that in Western Han. However, the palace CICs did not enlarge itself, which suggests that the construction of CIC is mainly limited by the stable life style and population of ruling classes. Another feature of capital Chang'an is that the size of Chang'an in Tang is about 9 times as big as the King City of Zhou in Luo'yang area. The huge scale of the city area for normal residents in the capital of Tang was characterized by the orthogonal grid roads and 108 walled and gated Li Fang *里坊*. By controlling the gates of each Li Fang, people living inside a Li Fang were forbidden to enter the public streets from the Xushi *戌时* (an ancient Chinese time period between 7 pm and 9 pm) to Yinshi *寅时* (between 3 am and 5 am) of the next day. Though the Li Fang was large and there were also public services inside, it was not self-sufficient due to the lack of collective production and consumption as that guaranteed by Xiang Li system *乡里制* (Figure 2.3 and Table 2.1) in rural areas.

• The city Luo'yang in Tang dynasty

Like Zhou and Han dynasties, the Tang dynasty also established an east capital city in Luo'yang area. In contrast to the other two dynasties, the capital city Luo'yang in Tang was built to the east of the King City of Zhou ruins and overlapped the ruins of early Cheng'zhou city (Figure 5.26). Another change was that the palace city and one part of the outer city were constructed on the north of the Luo river *洛河* and the rest of the outer city was constructed on the south of the river. Moreover, the imperial/palace CIC in Luo'yang was constructed on the northwest of the capital where the terrain was higher than other parts of the city. The threat of frequent flooding of the Tai Ji palace *太极宫* of Chang'an in Tang was avoided by the planning of the palace city of Luo'yang (Dong, 2018). Therefore, in Luo'yang, Guan Zhong's theory of city design was applied to construct the city to adjust to objective natural conditions. Though the palace city was not located on city axis, where the terrain was lower, the single CIC structure and the orthogonal road system advocated in King City Map of Zhou were employed in the planning of Luo'yang.

Figure 5.26 shows that in the six capital cities for different large dynasties located in Luo'yang area, the capital city of Tang in Luo'yang has the largest outer city walls and the largest single CIC. In addition, in a comparison based on archaeological findings, the city Luo'yang in Tang is about 8 times larger than the King City of Zhou. Even though in a warm and wet period between 600 A.D. and 1280 A.D. with rich nature resources, both capitals thriving in Tang dynasty did not follow the city planning structure in Qin and Han. Instead, they follow a similar mechanism with Zhou dynasty because they had to support and protect the urban life for citizens with a population about from 500,000 to one million.

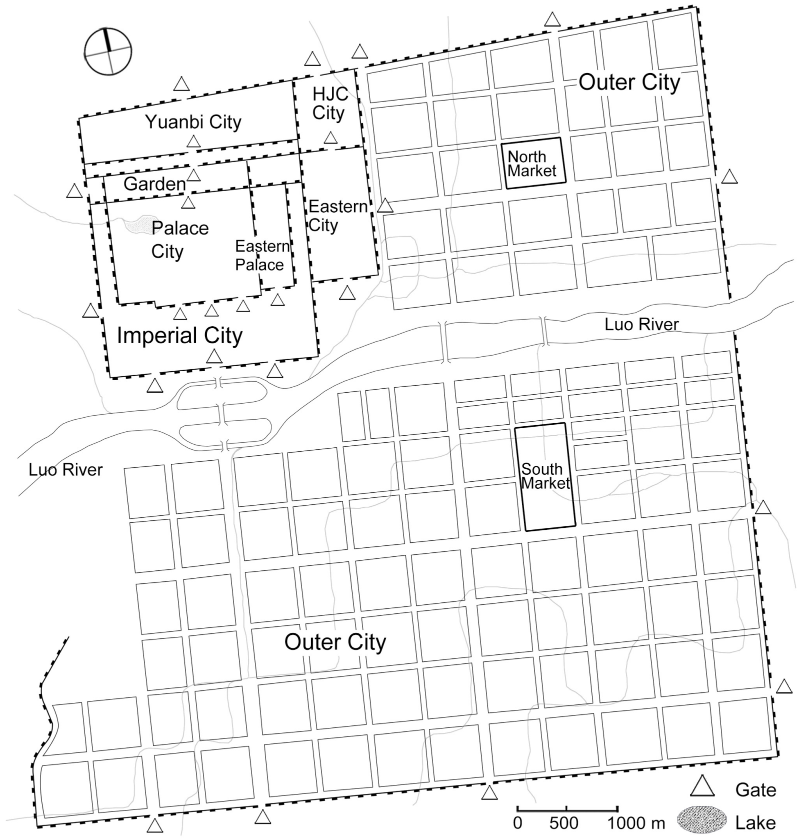


Figure 5.25. Capital city Luo'yang in Tang dynasty (case study 10 in figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Dong, 2018, Zhao, 1987, Luoyang Tangcheng Team of Institute of Archaeology in Chinese Academy of Social Sciences, 2003).

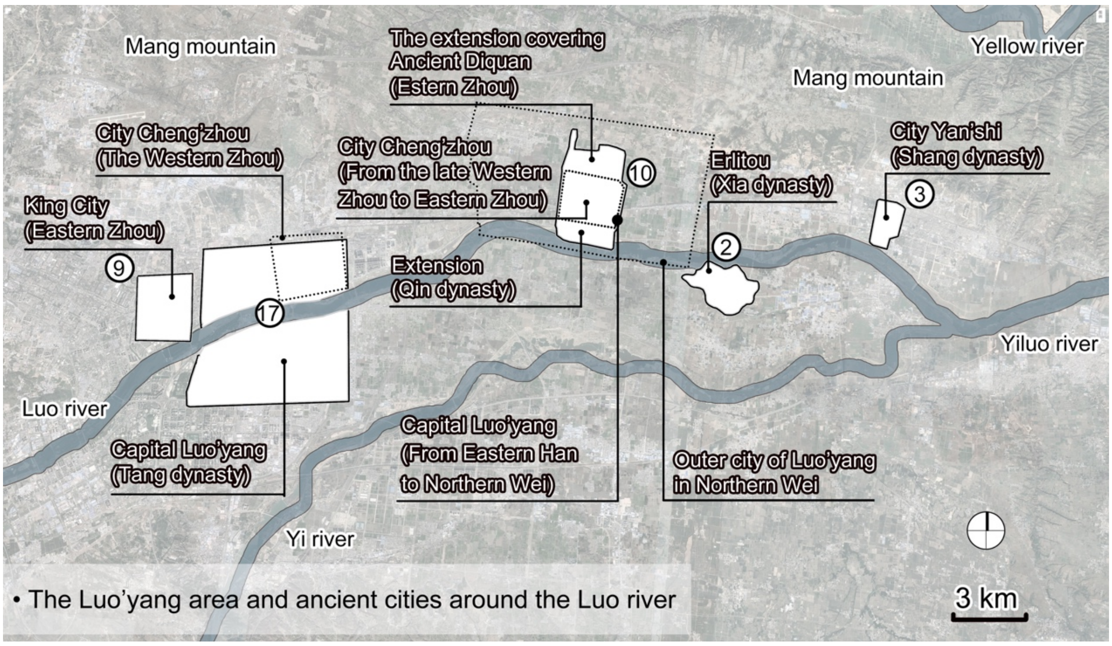


Figure 5.26. The capital cities which were built during different dynasties in Luo'yang before Song dynasty. This figure reflects the urban expansion type of **E5** in figure 5.40 and 5.41. The background urban map of the modern city Luo'yang is made from the Google earth map. PS: Cheng'zhou city had two locations: the early one overlapped with the northeast of capital city Luo'yang in Tang dynasty and the later one overlapped with

the central area of the capital cities from East Han dynasty to North Wei dynasty (Cai and Yu, 2016, Hou, 2016). Figure drawn by the author.

• The capital city Dong'jing in North Song dynasty

After Tang dynasty, the natural environments surrounding Chang'an and Luo'yang deteriorated and the main capital cities began to be relocated to the east of China. Dong'jing *东京* (also called Kai'feng *开封*, Bian'liang *汴梁* and Bian'jing *汴京*) was upgraded from a local city named Bian'zhou *汴州* in Tang dynasty to the capital of Northern Song dynasty (case study 18 in Figures 5.1 and 5.2).

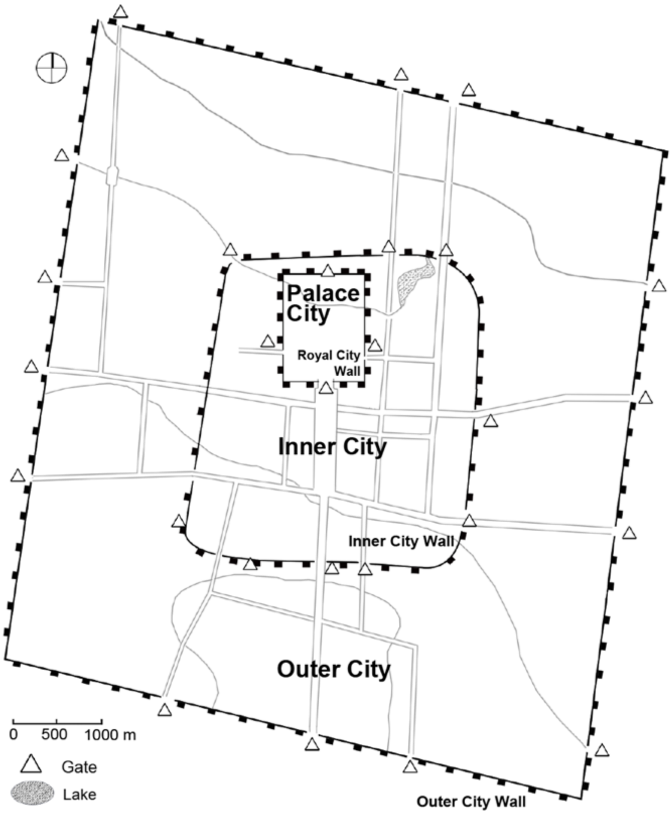


Figure 5.27. Capital city Dong'jing of North Song dynasty (case study 18 in Figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Li, 2017, Liu, 2004).

In Northern Song dynasty, the commercial streets, replacing the market and Li Fang, played a significant function in people's public life of capital city Dong'jing. Unlike the Li Fang and market, which featured enclosed yards in Tang to support the public life inside the enclosures and gates, the streets in Song became the main place for public interaction and commercial exchange. Though the construction of the palace city in Dong'jing promoted urban expansion, the palace city was too small for the royalty. The central government intended to expand the palace city, but it was stopped by the Song emperor Zhao Guangyi *赵光义* (939-997 A.D.) because he was unwilling to disturb the normal citizens by forcing them to move out of the inner city (see Figure 5.27).

The first emperor Zhao Kuangyin *赵匡胤* (927-976 A.D.) in Song dynasty intended to build the capital of Northern Song in Luo'yang, the geography of which was surrounded by mountains offering an advantageous position of military defence. In contrast, though Dong'jing was located on the flat plain without topographical advantages for military defence, the river offered convenient water transportation and upper class interests had been solidified in Dong'jing, which led to aborting the plan to move the capital city to Luo'yang. The construction of the outer city walls in Dong'jing was a remedy to its defensive disadvantage. In contrast to the low outer city walls of Luo'yang in Northern Wei, the high outer city walls of Dong' jing in Northern Song reflected the need in Song to defend against invasion by northern and west nomads. The capital city Dong'jing was divided into the palace city, inner city and outer city by three concentric city walls (Figure 5.27). However, the city walls did not prevent the military of Jurchen Jin dynasty from capturing emperors of Northern Song in 1127 A.D, which directly led to the downfall of Northern Song.

In Song, Yuan, Ming and Qing dynasties, there were artists painting the street life of capital Dong'jing with the theme Qingming Shanghe Tu *清明上河图* (English translation: Life along the River During the Qingming Festival). In Figures 5.28 and 5.29, two famous artists depicted the town life along the water in a similar way but also suggested different urban features. In the first scroll painting (Figure 5.28) by Zhang Zeduan *张择端* (~1085-1145 A.D.) in Northern Song, there is only one city gate without clearly connected city walls for military defence. Moreover, the palace life has disappeared in the painting because the CIC is nowhere to be found. In contrast, in the second scroll painting (Figure 5.29), the artist Qiu Ying *仇英* (~1495-1552 A.D.) in Ming dynasty depicted a scene of Dong'jing during Song dynasty with two city walls segregating the palace and inner city as well as the inner and outer cities. The versions painted by artists in Yuan and Qing dynasties also characterized the city lives as being segregated by walls. But the question is why the paintings of Dong'jing in Song dynasty by individuals from Ming dynasty to Qing dynasty presented more comprehensive information on lives between city walls while the Northern Song artist himself only depicted the public life of inner and outer cities and only ambiguously represented the city enclosure system. One possibility is that the painting by Zhang Zeduan is incomplete. A common feature of Figures 5.28 and 5.29 is the similar population densities inside and outside the gate of inner city. In contrast, the palace city in Figure 5.29 has a much lower population density. In addition, the urban lives of the inner city and outer city have no prominent distinctions in densified land uses of working, service and residence, which is different from that in the palace city where the buildings with low densities and large-scale landscapes were utilized by a lower population density (see Figure 5.29).

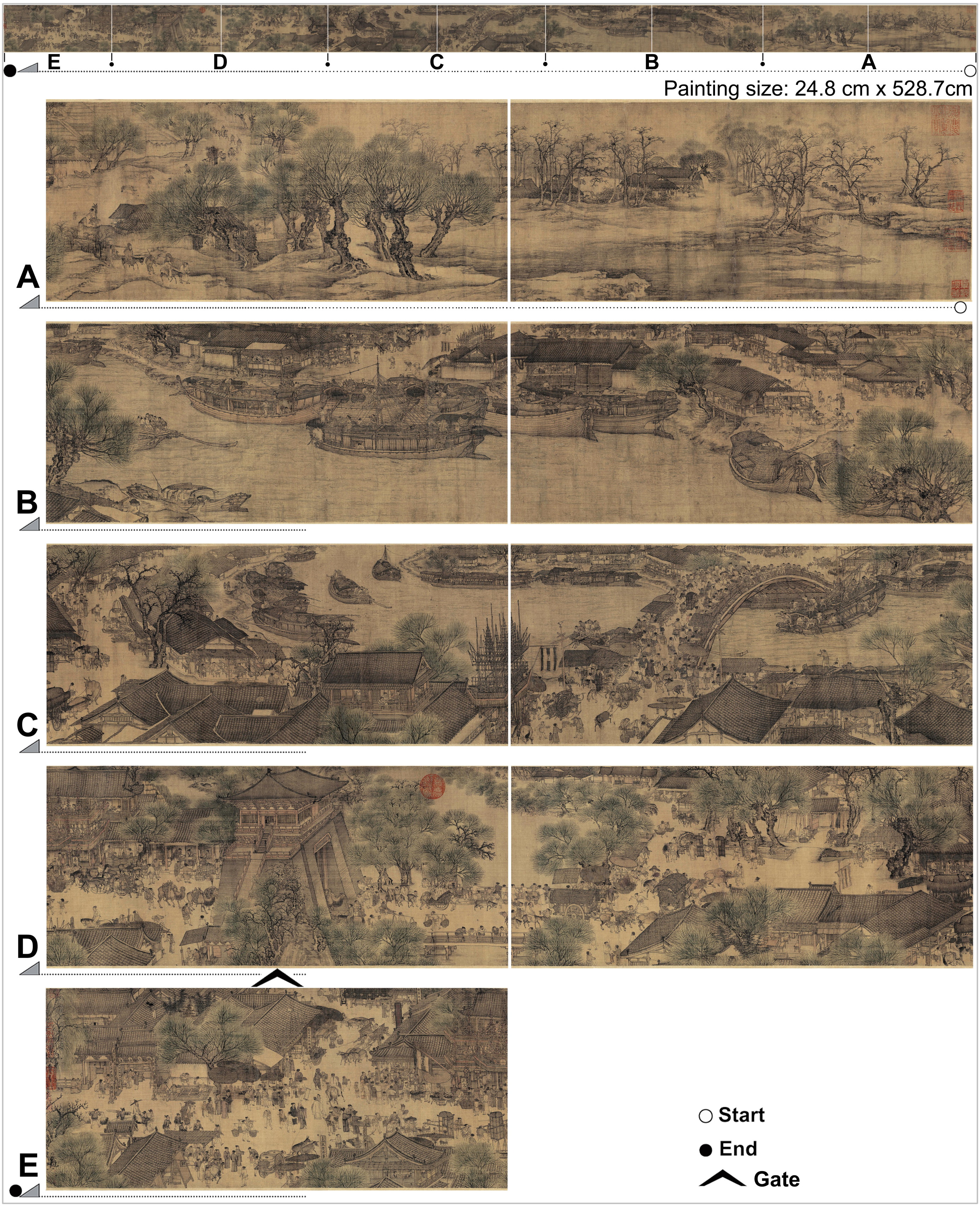


Figure 5.28. Qingming Shanghe Tu *清明上河图*. Painting by Zhang Zeduan (~ 1085-1145 A.D.). Resource © Palace Museum in Beijing.

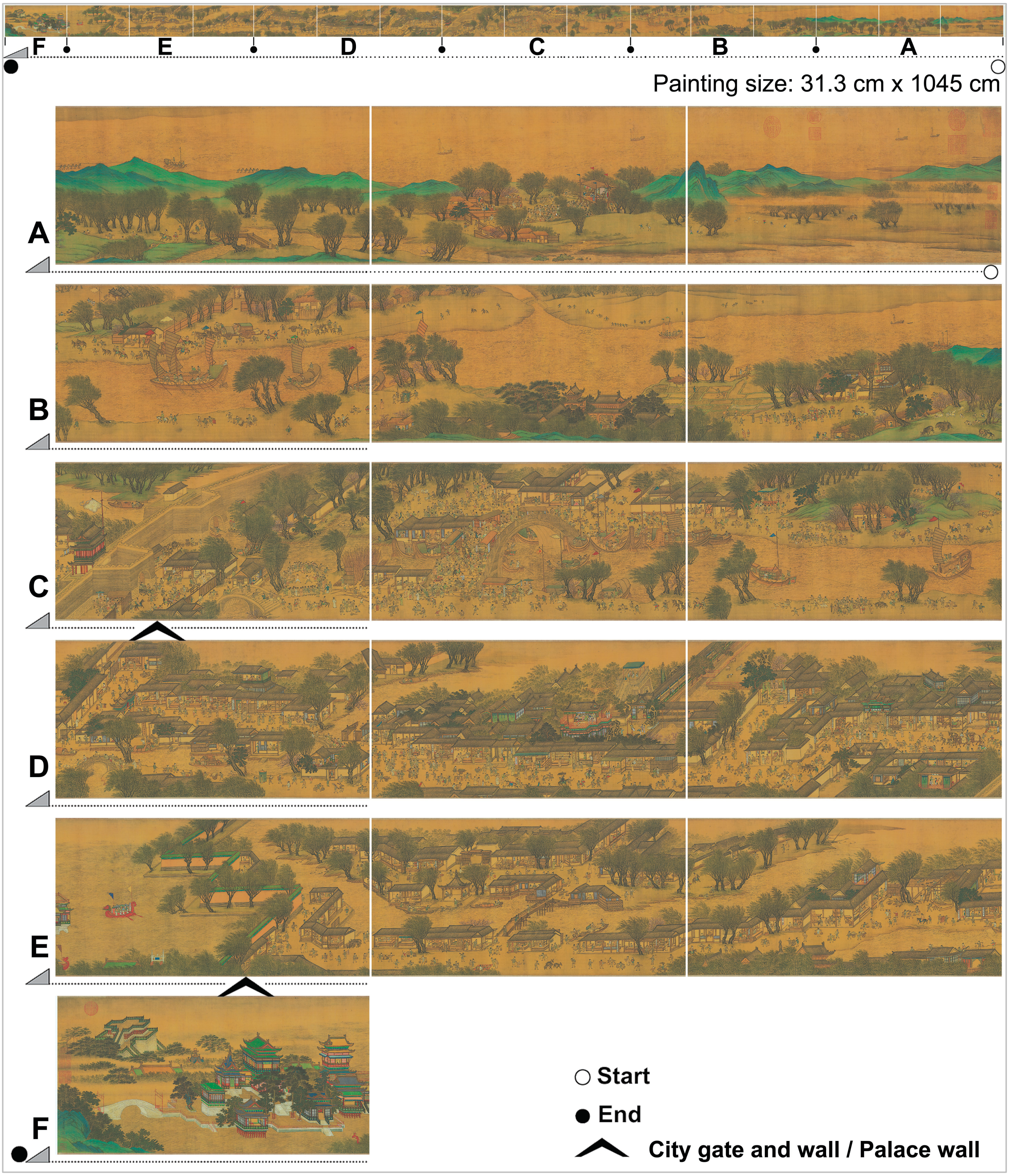


Figure 5.29. Qingming Shanghe Tu *清明上河图*. Painting by Qiu Ying (~1495-1552 A.D.). Resource © Museum of Liaoning Province, China.

• **The capital city Lin'an in Southern Song dynasty**

The construction of the capital city Lin'an 临安 had to be adapted to the dense rivers and hilly terrain of South China, which led to the irregular contour of the inner city as well as the outer city. In contrast to earlier capital cities, the outer city of Lin'an was much larger than the inner city as the increasing military threat from the north forced the city planners to include the farmland within the outer city to guarantee the food supply if the capital was ever surrounded by invaders (see Figure 5.30). Similarly, the inner city of Lin'an functioned as the imperial city, while the normal citizens lived in the outer city. Due to the large area and increasing immigration, the total population of Lin'an rose to 2,500,000.

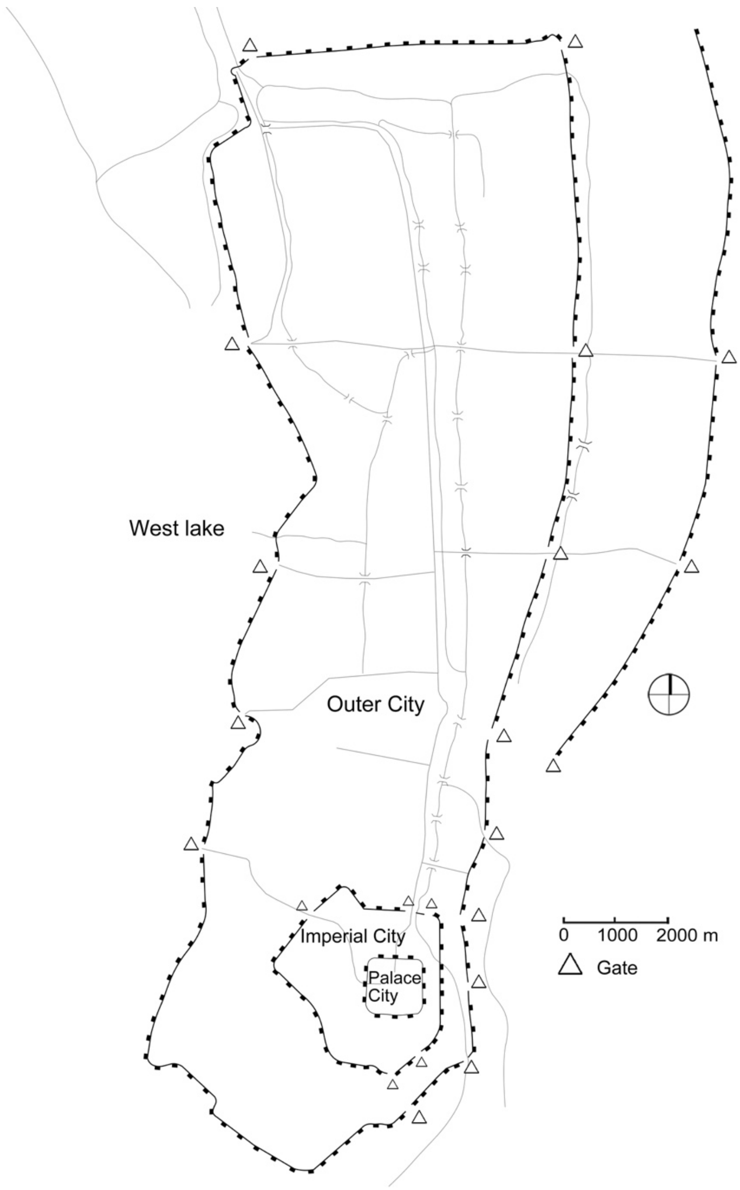


Figure 5.30. Capital city Lin'an 临安 of Southern Song dynasty (case study 19 in Figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Cheng and Hsu, 1980, Tang and Du, 2008).

• **The capital city Da'du (Khanbaliq) in Yuan dynasty**

In the last years of the warm and wet climatic period, the Mongolian people established themselves as a strong military force based on a well-trained, growing population. Moreover, the advantageous climatic resources also benefited the increasingly corrupt and degenerate Jurchen Jin and Southern Song dynasties. The Mongolian elites intended to benefit from the governance theories from Confucianism and Taoism by adopting their proposals. Even though emperor Kublai (1215-1294 A.D.) successfully established the huge empire of Yuan dynasty incorporating the tribes unified by Genghis Khan (1162-1227 A.D.), the new empire had to confront the coming cold and drought period and endless peasant uprisings. In Da'du *大都*, the outer city (Figure 5.31) played a key function in managing the growing population from different races. The original citizens lived in Zhong'du during Jurchen Jin dynasty and migrated in Da'du after its construction. The city Zhong'du itself maintained a complex ethnic and class division, which was separated by city walls (see Figure 5.33).

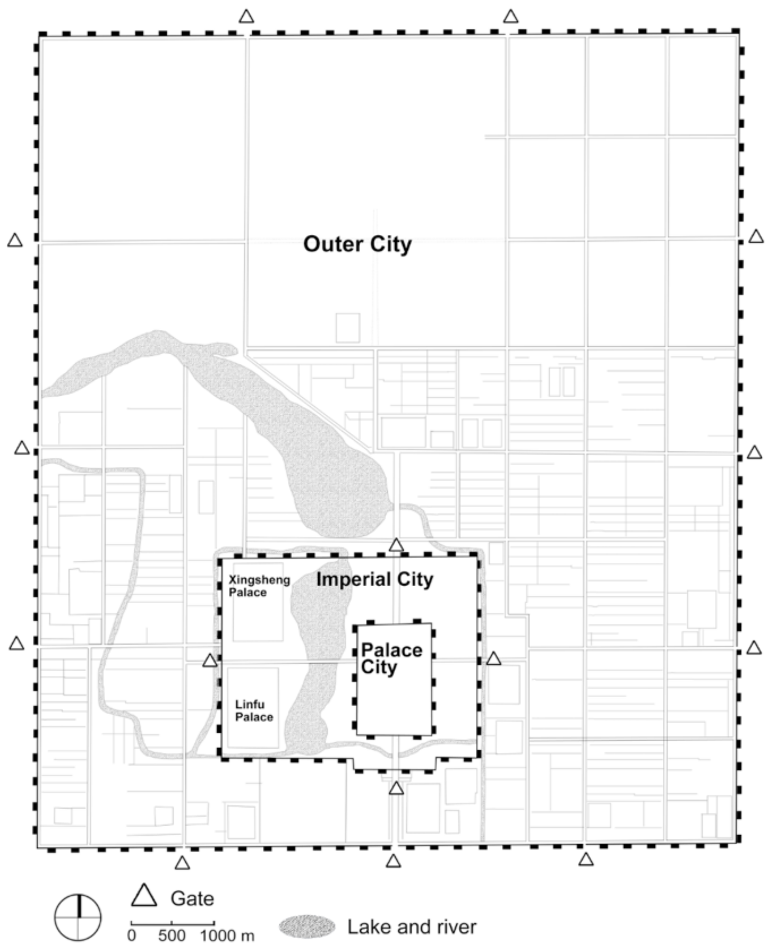


Figure 5.31. Da'du 大都 of Yuan dynasty (Case study 20 in Figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Hou, 1997, Cheng and Hsu, 1980).

The capital city Da'du was designed by the Confucian politician named Liu Bingzhong *刘秉忠* (1216-1274 A.D.), an senior state policy adviser and a master of Chinese Feng Shui

(I-Ching is the core to understand Chinese Feng Shui) in urban planning. Though the empire of Yuan lasted less than a hundred years of prosperity, the city structure of Da'du was preserved and transformed into the capital city of Bei'jing in Ming and Qing dynasties. Da'du was designed with a central urban axis. Moreover, the triple city walls divided the city into zones for different social classes.

• The capital city Nan'jing (Ying'tian'fu/Jin'ling) in Early Ming dynasty

As the cold and drought period slowly took hold, the harsh weather undermined the basis of both agriculture and animal husbandry. This unfavourable situation, added to the increasing number of peasant uprisings in Yuan dynasty, inspired Zhu Yuanzhang *朱元璋* (1328-1398 A.D.), born into a poor peasant family, led a rebel army to do battle against and defeated the military of Yuan empire. He then founded the Ming dynasty in 1368 A.D. in the capital city Nan'jing *南京*.

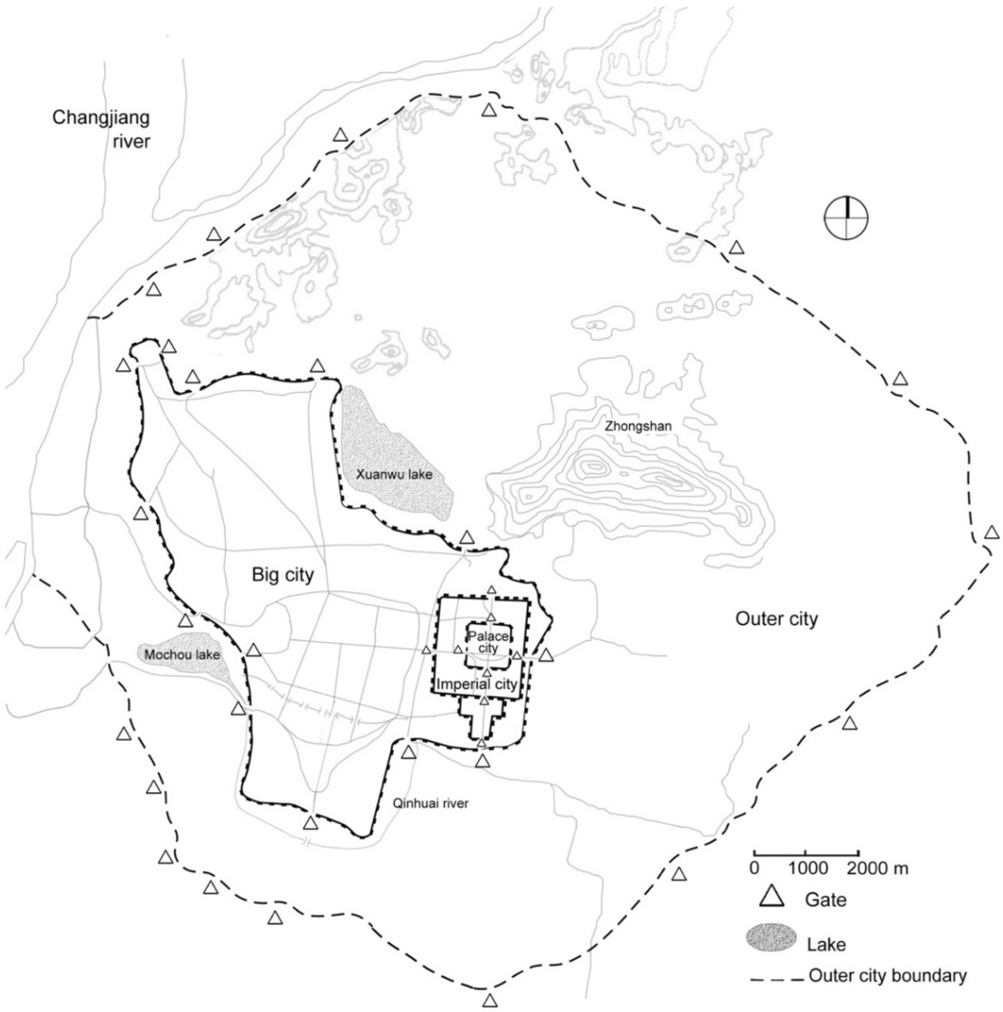


Figure 5.32. Capital city Nan'jing *南京* in Ming dynasty (study case 21 in Figure 5.1 and 5.2). Figure adapted by GU Yan and LI Chenghui from (Pan, 2001).

Nan'jing became the first capital city located in the south, established by a dynasty that re-unified the south and north state territory. This period only lasted from 1368 A.D. to 1403 A.D. and the capital city was then moved to Bei'jing by Emperor Zhu Di 朱棣 (1360-1424 A.D.). Nan'jing was constructed as a clear quadruple-walled city structure (see Figure 5.32). Similar to Lin'an in Southern Song dynasty, the big city and bigger outer city of Nan'jing did not have a rectangle shape. However, the palace city and inner city of Nan'jing preserved the concentric square-shaped city walls, which were smaller than that in Bei'jing, to create a typical CIC for ruling elites.

• The capital city Beijing in Ming and Qing dynasties

In Ming dynasty, Bei'jing was established, for the second time, as the capital for the large unified state. The ruling classes of Ming constructed the new capital city based on the design of Da'du in Yuan dynasty.

Figure 5.33 shows that the walls in ancient Bei'jing area, across different dynasties, were concentric and rectangle. The archaeological remains are located very close to and sometimes even overlap each other. Early Bei'jing in Ming dynasty had a structure similar to that of Da'du in Yuan dynasty. In contrast, the imperial city Bei'jing in early Ming dynasty was larger than that of Da'du, though the outer city of Beijing in early Ming was smaller than that in Da'du. When the Ming ruling class rebuilt Bei'jing, the palace city and the imperial city became the geographical centre of the capital in imitation of King City of Zhou, and in doing so the Ming emperor Zhu Di declared himself as the son of heaven (Tian Zi 天子).

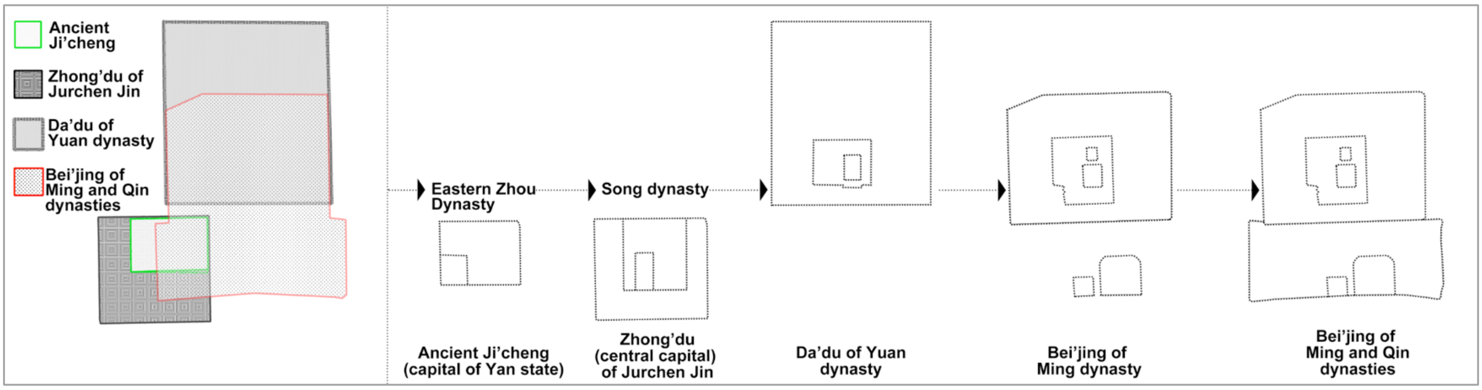


Figure 5.33. The capital cities of different states and dynasties in ancient Bei'jing area. Figure adapted from (Hou, 1986, Steinhardt, 1999) by the author.

As shown in Figure 5.33, from Eastern Zhou dynasty to early Ming dynasty there were no obvious changes to the triple-walled structure of Bei'jing. However, the city structure was transformed according to a different expansion logic by emperor Jia Jing 嘉靖 (1507-1567 A.D.) to protect the growing population from attacks by northern nomads. The new outer city wall was constructed as a southward extension of the wall which lay outside the original city (see Figure 5.35). However, this special design was not the first choice for urban expansion plan in Jia Jing's mind.

The threat from the northern nomads and weak state strength of Ming prompted to the construction of outer city walls. The growing of population and the wealth created by the people outside the city walls needed much more protection by the central government. Without city walls, these people were vulnerable to being plundered by invading northern nomads. In the beginning (1549 A.D.) the emperor Jia Jing and his ministers at planned to construct a huger outer city wall that could enclose the original capital city (see the left map in Figure 5.34). Even though the cold and dry weather helped the Ming rebel army overthrow the ruling Yuan dynasty, the continuing cold and dry weather also negatively impacted agriculture production during Ming dynasty. In addition, the defensive wars against the north-west nomads and coastal pirates also weakened the empire. The difficult financial situation limited the government' s ability to organize enormous human and material resources for the construction of outer city walls. Honoured as the son of heaven, Jia Jing hoped to maintain the central location of the palace city in the expended capital city, which symbolized the legality of his ruling based on the deep belief in Rites of Zhou. Though the emperor Jia Jing planned to construct a quadruple-walled city in line with the planning rules of King City of Zhou, the pragmatic plan of constructing a smaller outer city won in the end. The dense population, with a large number of merchants living in the south outside the city, was enclosed by the newly built smaller outer city walls in 1553 A.D. The ruling elites in Qing dynasty preserved the city structure of Ming Bei'jing.

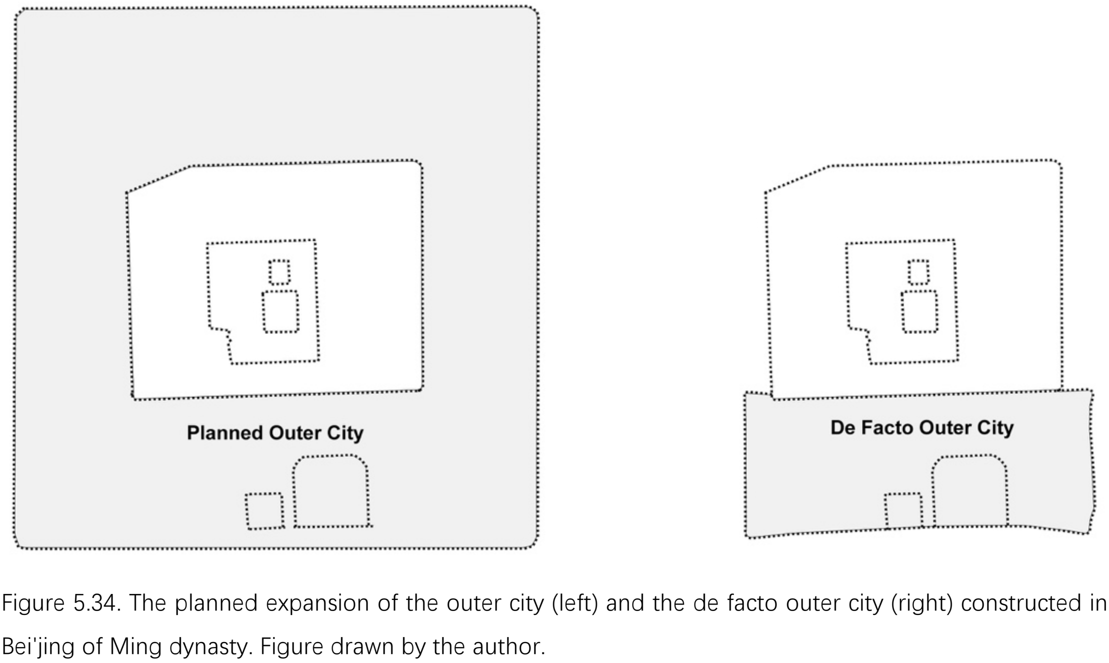


Figure 5.34. The planned expansion of the outer city (left) and the de facto outer city (right) constructed in Bei'jing of Ming dynasty. Figure drawn by the author.

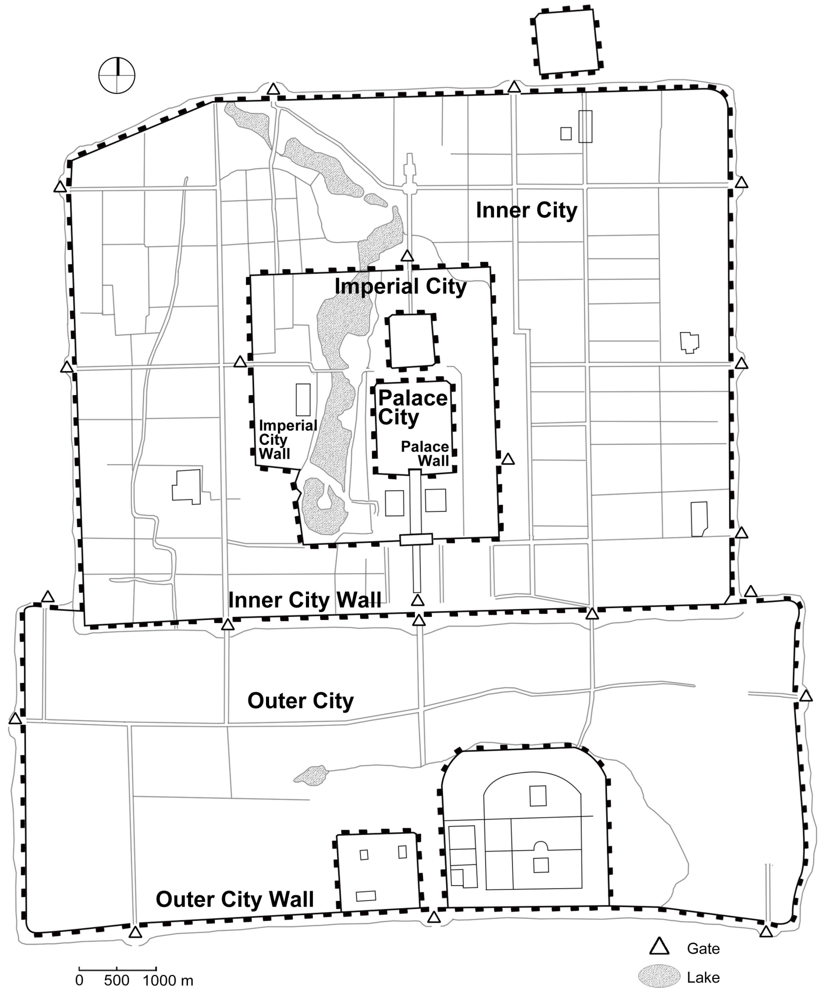


Figure 5.35. Capital city Bei'jing of Ming and Qing dynasties. Figure adapted by GU Yan and LI Chenghui from (Cheng and Hsu, 1980).

The cold and drought weather caused frequent and terrible natural disasters in late Ming dynasty, which also intensified the conflicts between aristocrats and peasants. The political and military corruption of the ruling class in Ming dynasty weakened it, enabling the successful invasion of the rising north nomad dynasty called Later Jin *后金* (1616-1626 A.D.). Later Jin was the regime founded by Manchu people who called themselves the descendants of Jurchen Jin dynasty. The Later Jin elites founded Qing dynasty to replace the Ming dynasty. The city structure of Beijing during Ming dynasty was preserved by the emperors in Qing dynasty. The forbidden city and imperial city built for upper classes in the capital Beijing in Ming and Qing dynasties (Figure 6.35) became the last pre-industrial palace CIC, which integrated the housing and state governance of the ruling elites.

The male nobles lived in the palace and had the freedom to communicate with the world outside. The ruling classes generally carried out their daily administrative duties in imperial/palace CICs. There were also some offices for the ministers to work within palace

CICs. The imperial concubines and maidservants, in contrast, were not allowed to explore the outside world. The maids, eunuchs, guards and doctors in the royal houses, offices, studies, gardens, theatres, temples, kitchens within royal/palace CICs supplied rich entertainment and health care services for the ruling classes.

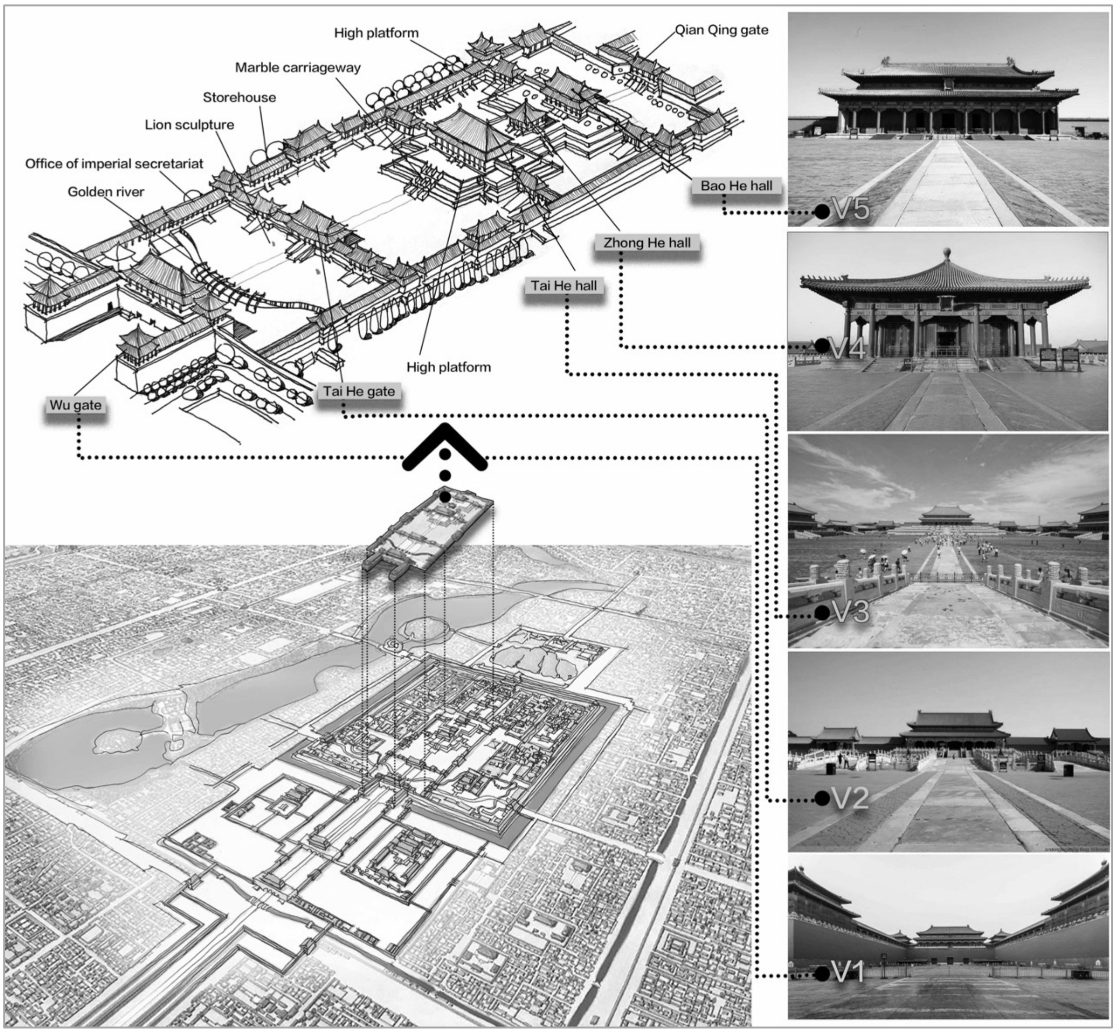


Figure 5.36. The Forbidden City in Bei'jing. The buildings between V1 and V5 in the zoomed-in Figure constitute the state governance centre in palace city. The other supporting functions were arranged in buildings surrounding the zoomed-in area. Figure adapted from (Gu and Wang, 2018) by the author.

Xu Yang *徐扬* and Ding Guanpeng *丁冠鹏*, the royal painters of emperor Qian Long *乾隆* (1711-1799 A.D.) created two paintings of urban life in Bei'jing. However, the two paintings reflected contrary perspectives. The first one (Figure 5.37) is a view from outside the CICs to portray the lives inside them, while the second one (Figure 5.38) is a view from inside the palace CIC to the life outside the CIC walls. The comparison between two paintings reveals features about population density, floor area ratio (FAR) and other information about life in and outside the CICs in Bei'jing from a more western perspective than the paintings depicting the Han palaces. Even though the two paintings have different perspectives, they reveal the similar attributes about city life in Bei'jing in Qing dynasty. First, the residences in the urban areas outside the royal CICs are closer to each other; second, there were more people outside the CICs enjoying the public street life; third, the people inside the royal CIC enjoyed a better environment condition with various gardens and magnificent architecture complex. In the first painting, the busy lives of people inside the palace city was reflected in the gathering of people around the outer court area[26]. The people skating on the ice-covered lake in the northwest (on the left side of the palace city in this painting) of the imperial city also revealed the vivid enjoyment life in imperial/palace CIC. However, the large proportion of fields and temples in the royal/palace CIC also suggested a lower residence population density inside.

Figure 5.37. Poetic early spring in Beijing *京师生春诗意图* drawn by Xu Yang in Qing dynasty. Figure ©The Palace Museum in Beijing.

[26] The outer court (zoomed-in figure) including the three halls depicted in Figure 5.36 functioned as the political centre for the emperor to meet and discuss serious matters with his ministers.

Figure 5.38. Taicu Shihe Tu *太簇始和图*. Drawing by Ding Guan-Peng in Qing dynasty. Figure ©The Palace Museum in Beijing

5.1.7 Ancient CICs of palace cities and normal citizens' inner cities: a city planning response to agricultural production, population management and military defence

The lineage of ancient CICs in China was deeply influenced by agricultural production. First, the single-walled palace structure in King City Map of Zhou derived from the ancient farmland system of Jing Tian (see Figure 2.2 and Table 2.1). The system in rural areas in which the state owned one central piece of farmland and the surrounding eight pieces of farmland were private was transformed into the central single palace CIC accounting for 1/9 and surrounding residence areas accounting for 8/9 in capital cities. The construction and transformation of the palace CICs throughout different dynasties were based on the strengthening or weakening of the planning rules in King City Map of Zhou (Figure 5.40). Moreover, in Figure 5.39, except for the late eastern Zhou, Qin and Han dynasties, most of the dynasties employed the planning rules reflected in King City Map of Zhou. Second, the financial strength to construct the palace CICs was limited by the agricultural products and taxes collected from the peasants. The climatic requirements for abundant agricultural production during the four cold and drought and the four warm periods in China strongly limited the construction of ancient CICs. In Figures 5.39 and 5.40, every expansion of city structures appeared in or close to a warm and wet climatic period (Qin, Western Han, Tang and Northern Song) or located in south China with warm temperatures and adequate rain (Lin'an in Southern Song and Nan'jing in early Ming). In contrast, the cold and arid periods reduced the agricultural production which further weakened the strength of the empire to expand their capital cities and palace CICs (e.g. dynasties including Eastern Han, Three kingdoms, middle and late Ming).

Population management in ancient capital cities was accomplished dividing those who lived inside palace cities and those inner/outer cities. In particular, the production of inner cities and larger outer cities for normal residents suggests the modification of planning rules established in Western Zhou to manage the increasing population by regionally unified empires after Han dynasty (Figure 5.41). Though the size of some single palace CICs became larger, the increasing size of new outer cities led to a decrease in the proportional size of the palace CICs in the capital cities. To some extent, the inner cities functioned as buffer zones between outer cities of highly mixed societies and palace cities of the upper classes. However, the consumption and production in inner and outer cities were relatively scattered for normal citizens, which suggested that the lives in inner and outer cities of ancient capital cities were not self-sufficient as that within the imperial/palace CICs. The large number of yards within the inner cities isolated the neighbourhoods without blood ties and created a private domain for each family. Moreover, the many small home handicraft industries failed to transit into a mass production collective in urban areas. In contrast, the ancient CICs of palace/royal cities typically integrated state governance and royal life to establish a collectivist ancient CIC life, which, similar to the collective management of production and consumption in rural areas, derived from the clan system in agricultural societies of ancient China.

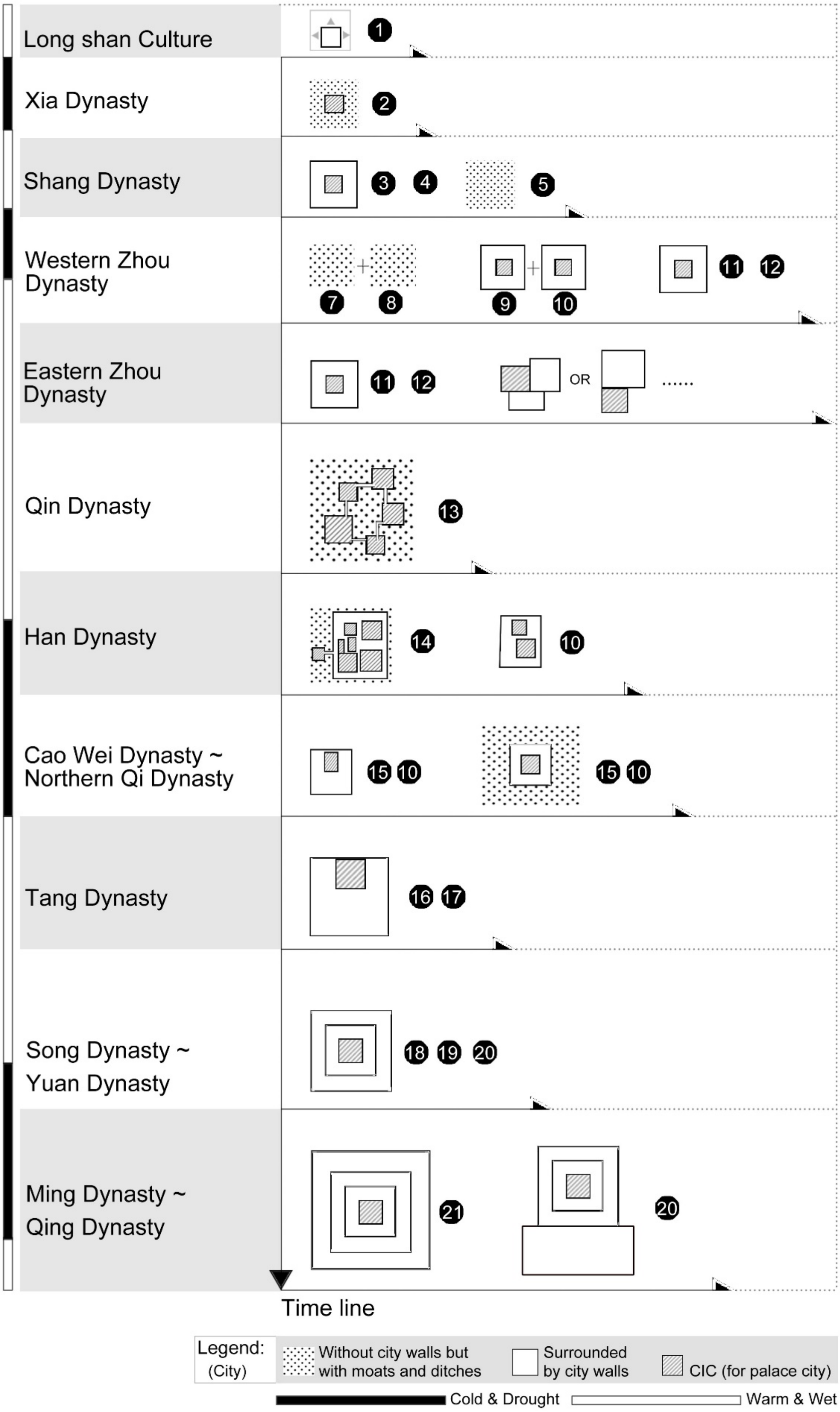


Figure 5.39. The formation and transformation of CIC structures across dynasties and regions. Figure drawn by thec author.

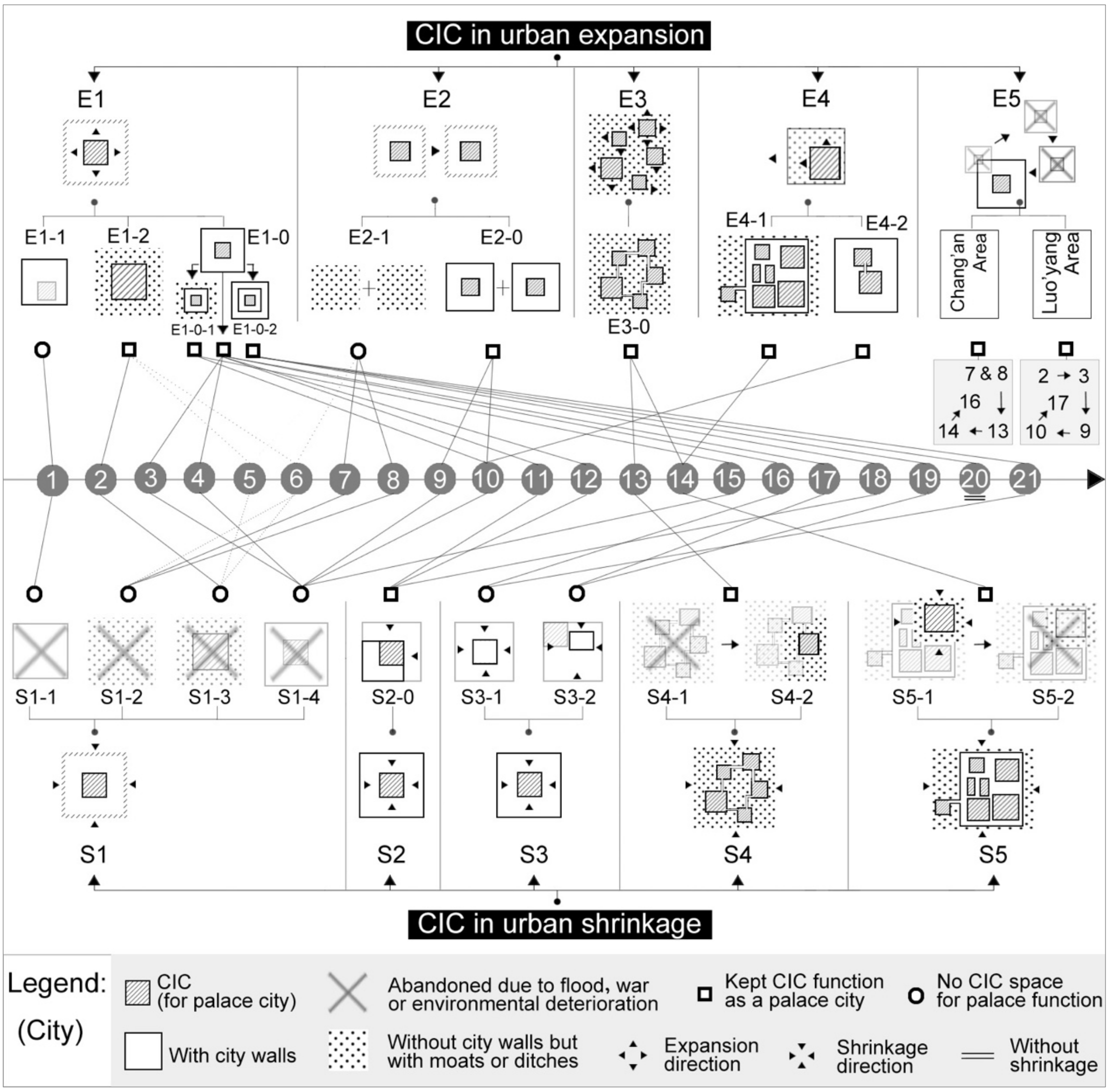


Figure 5.40. CICs in expansion and shrinkage of capital cities of different dynasties. Figure drawn by author.

E / S		E1					E2		E3	E4		E5	
		E 1-0	E 1-0-1	E 1-0-2	E 1-1	E 1-2	E 2-1	E 2-2	E 3-0	E 4-1	E 4-2	C	L
S1	S1-1				1	2							2
	S1-2							7 8				7 8	
	S1-3					5 6	6						
	S1-4	3 4	10 15	18				9 10			10		3 9
S2	S2-0	11 12											10
S3	S3-1	16										16	
	S3-2	17 11		21								13	17
S4	S4-1								13			13	
	S4-2								13			14	
S5	S5-1								14	14		14	
	S5-2								14	14			
NS	No S	19 20											

Table 5.3. The classification of information in Figure 5.40. Table drawn by the author.

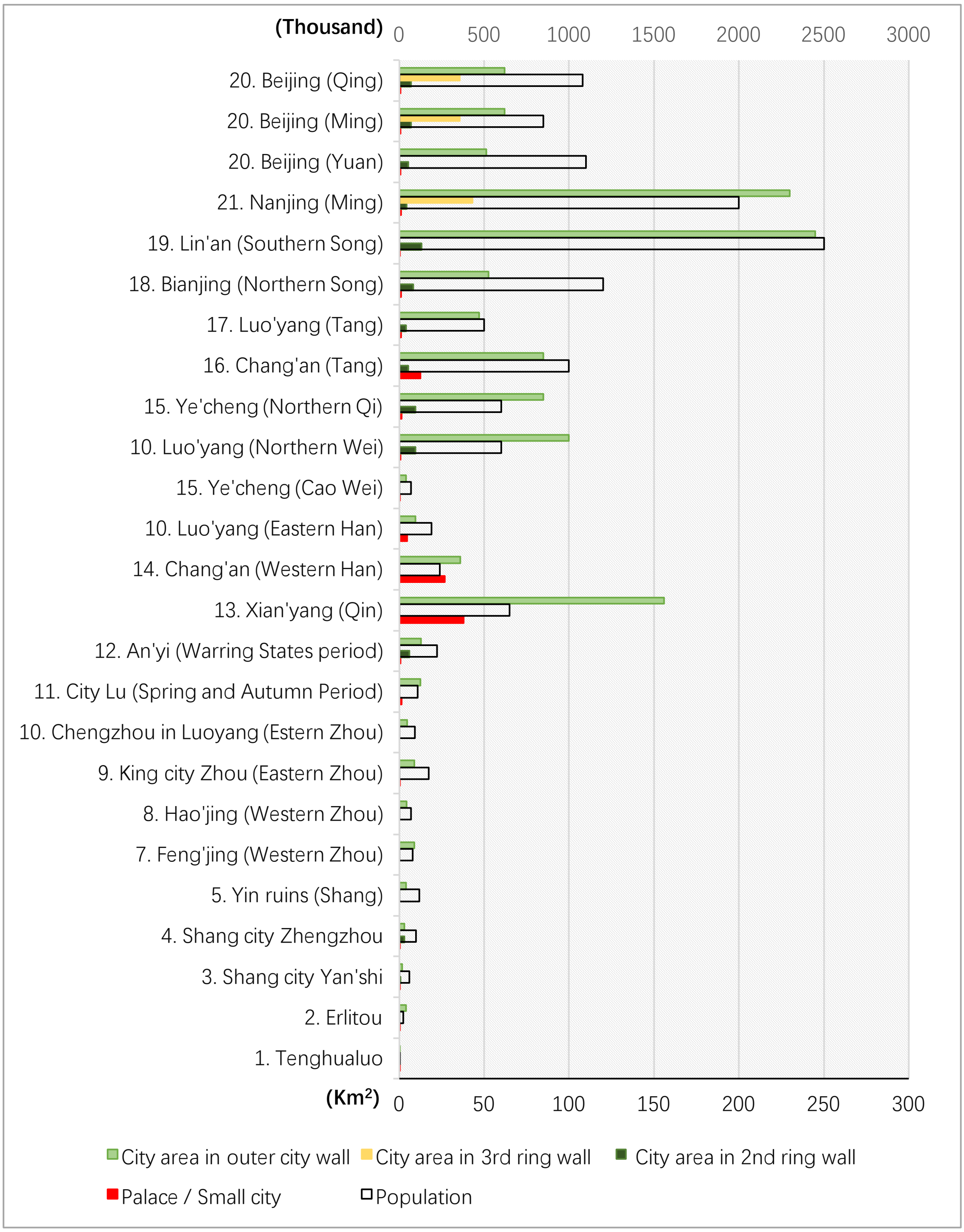


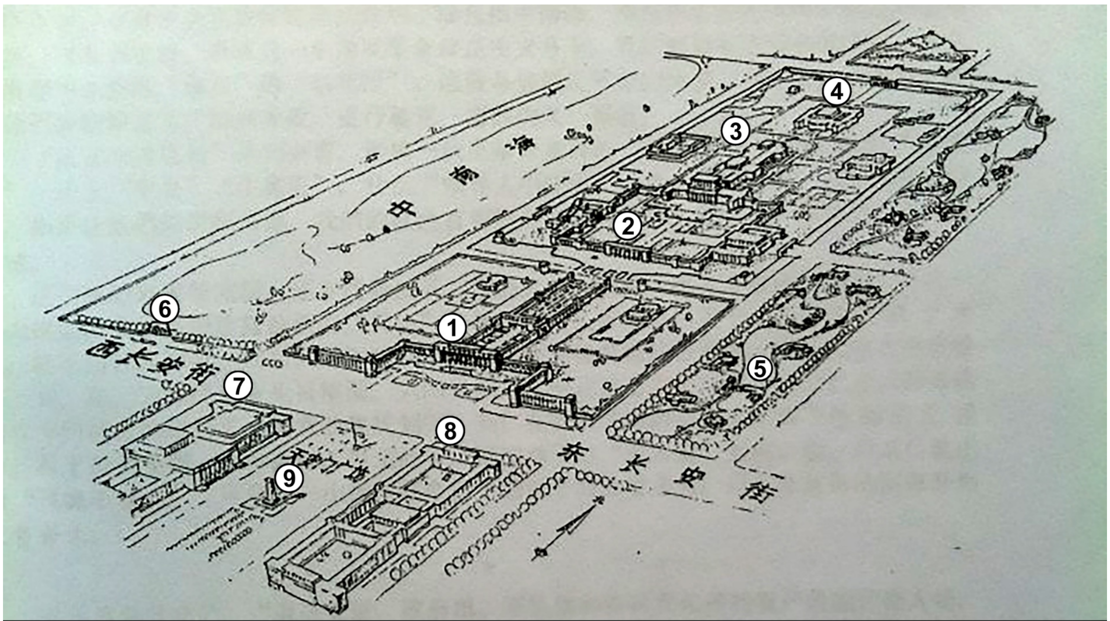
Figure 5.41. The population and size of selected capital cities in different dynasties of China. Figure drawn by the author.

The necessity of military defences against invasions from outside and uprisings from inside led to the construction of outer city walls and palace city walls. However, this feature became less common due to the invention of weapons with gunpowder.

5.2 The eve of modern CICs: a social transformation between the fall of Qing dynasty and the founding of the People's Republic of China

5.2.1 The transformation of the last active palace CIC into a palace museum after the fall of Qing dynasty in 1912

The fate of Forbidden City, the last imperial CIC in pre-industrial China, was uncertain in the period before 1949. This palace city fell into disuse after the last Chinese emperor was driven out in 1924 and only a small part of it was converted into the museum for citizens. By 1949, the whole city of Beijing had survived the civil war and was set as the capital city. However, in the process of reconstructing Beijing, the new government demolished the magnificent inner/outer city walls and gates to improve the traffic flow. Moreover, the prominent walls of the south gate of the Forbidden City were also removed due to the construction of Changan avenue.



The planning map for the removing and transformation of the Forbidden City

① New Tiananmen ② Party center gate ③ Party center ④ Presidential palace

⑤ Centre directorate housing ⑥ Xinhua gate ⑦ Great hall of the people ⑧ Revolutionary museum ⑨ Mounment to the people's heroes

Figure 5.42. The unrealized plan to remove and transform the Forbidden City in 1963. Resource © (Dong, 2006).

Lu (2006) contrasts the fall of the ancient city walls in Beijing with the rise of the work unit walls in modern Beijing to reveal the urban change after 1949. Most of the walls of the Forbidden City are preserved as part of the world heritage and it is now the palace museum. The walls outside the ancient palace CIC in Beijing and the work unit CICs coexist in present-day China. While the preindustrial palace CICs are empty, the work units inside one or several enclosures developed over time a collective life style by combining urban consumption and production.

There were several times during the period between 1912 and 1965, different governments planned to transform the Forbidden City into an appropriate location for new government but these plans were never implemented. One event during the transformation of the Forbidden City into a palace museum threatened to remove it. In 1963, a plan was developed to replace the Forbidden City with new central government buildings (Figure 5.42). Wang (2003a) interviewed the designer who participated in the planning project, and discovered the designer himself did not believe his proposal would be realized. This was the last event to threaten the fate of Forbidden City and now it is preserved as a museum, which presents to the Chinese people the complex spatial structure for preindustrial collective CIC life. The zoning design for different functions including residence, state governance, sacrifice ceremonies as well as entertainment within large-scale enclosures with symmetrical and concentric orders has been preserved and transformed in some modern work unit CICs.

5.2.2 Did typical CIC life in China disappear between 1912 and 1949？

About 37 years separated the fall of the Qing dynasty and the founding of the People's Republic of China. Though the Kuomintang represented the interest of landlords and bourgeois as did earlier ruling classes of imperial China, they did not build new CICs. However, the traditional social relationship with collectivist production and consumption under independent management was still alive in rural areas of China.

The typical CICs with walls and gates were removed between 1914 and 1949, but the collective self-sufficient lifestyle was preserved in rural societies of China. Collective life for urban workers during the Republic of China (1912-1949) were influenced by the clan and acquaintance society in rural areas. Before the modern work unit CICs were established after 1949, the guild (Hang hui 行会) in Shanghai had played an important role in organizing migrant workers who wished to pursue a career or find a job in the city (Bray, 2005). However, the collective identities in that period were relatively loose and mainly based on the clan and acquaintance networks between immigrants from rural societies. The Kuomintang also implemented the Bao Jia system to organize the rural societies to defend against the communist guerrillas. In rural areas controlled by the communist party, the large number of scattered villages still preserved the ancient collectivist organization in agricultural production and consumption. Particularly when the communist central government failed to supply enough resources, the self-sufficient social management system in traditional rural areas contributed to relieving the burdens on both sides. In addition, Mao (1893 - 1976) even advocated the local self-help movement of production to support the revolution, which was also employed again in the establishment of public services in work unit CICs after 1949.

5.2.3 The forces creating modern CICs: pursuing industrialization and integrating the collectivist mechanism into urban production and consumption

• The clash between Chinese tradition and social revolution

The local elites in ancient rural areas of China played an important role in organizing agricultural production. The social consumption of food and public service in rural areas were also based on the local independent management. The managers of the Shi Wu Lian Zuo system (see Table 2.1) in Qin and Han, the Xiang Bao system in Tang as well as the Bao Jia system in Song had to be selected from the wealthiest and venerable local elites, most of whom owned rich farmland resources. With the devolution of administrative jurisdiction to these local elites and the guarantee of their interests by the ancient bureaucratic system, the self-sufficient production/consumption as well as independent governance were established in traditional rural areas before 1912. However, in the Chinese land reform movement between 1947 and 1953, the land resources of local elites were deprived and redistributed to the peasantry via egalitarian policies.

Approximately 46 million hectares of farmland was assigned to 300 million poor farmers. The central communist government later promoted collective production and consumption by founding the people's commune system. The land resources became state-owned properties and the state determined the prices of agriculture products. The price-scissors between industry and agriculture was established accordingly, which became a foundation to industrialize urban China.

• From the collectivist clan life in agriculture production to the social collective life in urban industrialization

In the clash between Chinese tradition and social revolution, the local gentry and clan systems were overthrown by the revolution, while the collective production and consumption mechanism was preserved and promoted by the political system. Moreover, this mechanism was transferred from the agriculture context to the industrial context by integrating the CIC structure, which further transformed the urban lives of normal citizens. The jobs and housing in work unit CICs for workers and their families were established to replace the ancient urban lifestyle for normal citizens in dense courtyard houses and public streets. In the industrialization of urban areas after 1949, the theoretical basis of the clan system was highly criticized by communists who wanted to replace it with the equalitarianism, collectivism and dedication advocated by Confucius.

Chapter VI

CICS IN MODERN CHINA: MECHANISMS FOR SPACE USE AND TRANSFORMATION OF ENCLOSURE-GATING SYSTEM AND LAND USE MIX

6 CICs in modern urban China: mechanisms for space use and transformation of enclosure-gating system and land use mix

6.1 The construction and transformation of modern CICs for work units established after 1949

6.1.1 Modern CICs: construction of work units inside and outside the ancient city of Beijing

Between the fall of the last feudal dynasty of China in 1912 and the founding of the People's Republic of China in 1949, dramatic social changes had impacted the Chinese people's world view. The influences of the Soviet revolution as well as the social reforms in other countries mingled with the local traditions in social China. Chinese people became eager to learn from the experience of developed industrial societies. Some founders of People's Republic of China, including Zhou Enlai (1898-1976) and Deng Xiaoping (1904-1997), had visited industrialized Europe and been impressed by it. Building an industrialized society in China was one of the top objectives of the Communist party. After 1949, the construction of modern work units underwent staggering growth in both number of projects and scale. Even though the removal of ancient city walls and buildings was criticized by preservation experts, the construction of urban spaces more conducive to urban traffic as well as sufficient spaces for urban consumption and production became the priority in municipal governance (Zhai, 2005).

Scholars are fascinated by the construction and transformation of those modern work units during China's urbanization process. Through the centrally planned economy established beginning in 1956, the Chinese government controlled state production in rural and urban areas (Wu, 2019). Landlords were deprived of suburban land resources which were reallocated to poor farmers as their private land between 1950 and 1953. Later, the collectivized production in rural communes constructed after 1953 led to the establishment of collective ownership of the land, which showed that the government had the ability to arrange the land use to construct work units surrounding the preindustrial towns in many cities. The Chinese government tried urgently to transform this weak agriculture country into a powerful industrial country (Pantsov and Levine, 2013). Beijing underwent a series of steps to transform the ancient city as well as to construct a large number of modern CICs for workers.

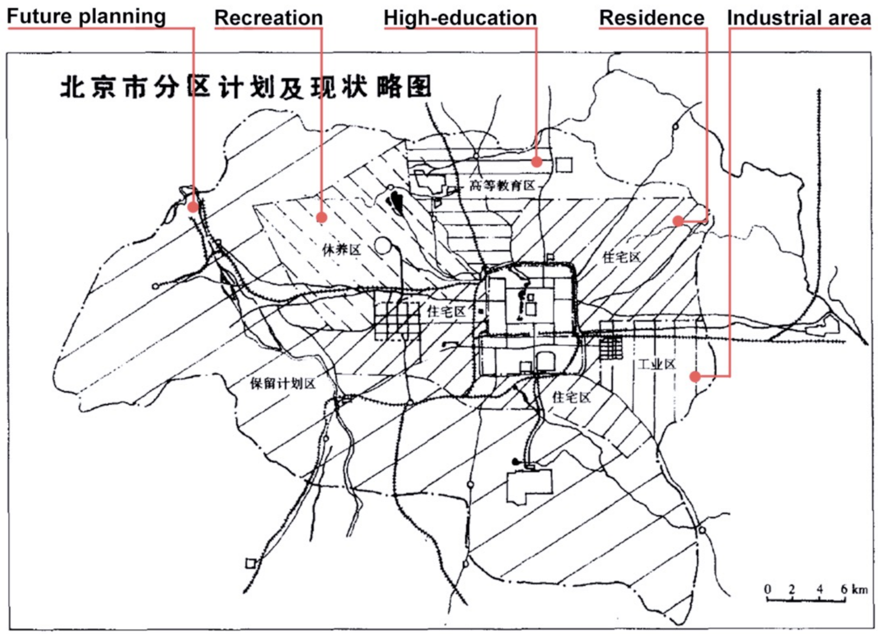


Figure. 6.1. The map of new urban planning concept for Beijing proposed by Soviet expert Barannikov in December of 1949. Resource: *Report from Soviet expert Barannief on Beijing's future development plan* © (Dong, 2006).

Beijing's new urban planning starting in 1949 became an opportunity to arrange the increasing population in suburban areas. The macro-scale urban zoning concept provided by Soviet experts (Figure 6.1) contributed to the concentrated distributions of higher-education areas and secondary industrial areas. The campus and enterprise locations were arranged into two areas outside the old town and far away from each other. Between them, there was a large residential area which was also outside the old city. Figure 6.1 creates an illusion that the teachers in the northwest and workers in the southeast would all live in the large-scale residence area separating them. However, most of the work units in both the higher-education and industrial areas integrated residences and working areas within their respective enclosures. Hence, the urban zoning tactics prevailing in soviet societies were only partly applied in the urban practice of Beijing. Simultaneously, many of the government agencies were constructed inside the old town, which scholars criticized due to the removal of ancient buildings (Wang, 2001). Mao fought back by accusing Liang Sicheng, a professor of architecture, of wanting to drive the government out of the ancient city. Liang Sicheng and Chen Zhanxiang proposed to construct a new city to the west of the ancient city and the government agencies were planned to locate in the new city. The Kuomintang party took all the national gold reserves as well as other wealth to the province Taiwan after the civil war. The country left in the hands of communist party lacked sufficient finances to support the splendid planning concept combining the construction of new large urban areas and preservation of the whole ancient city simultaneously in a short time. Finally, a compromise solution to transform and reuse the ancient city as well as to construct new CICs scattered inside and outside the ancient city was decided upon.

6.1.2 Spatial differentiation of modern CICs in China after 1978：develop campuses and transform factories in the market reform

• Develop campuses with space and population expansion: university CICs benefiting from educational and industrial strategies

After 1949, to reduce social inequality, the land ownership by landlords was abolished and the land was redistributed to the poor through land reform, which led to nationalized land in cities (Ding, 2003). By 1958 some of the land was still owned by collectives in rural areas (Zhang, 1997, Zhao et al., 1998, Yang and Wu, 1996). For higher-education campuses around the old cities, through the new land use policies for state ownership developed by the government after 1949, the universities had the priority to occupy their construction land as were other work units. Many of the campuses were surrounded by farmlands at the beginning. In this process, the Chinese government implemented the new land reform by realizing urban industrial production based on the development of work units. Moreover, the farmland resources were centralized in the hands of the government to be redistributed for urban development (Qu et al., 1995), which created a direct route for work units to get the land. The national land policy during urbanization was influenced deeply by the Marxist concept through extremely highlighting the labour's value during the pro-reform era: Capital and land had no value and all the value was conferred to labour in this newly-founded government (Zhang, 1997). The urgent need to resume post-war production was given priority over everything else. The land resources were reallocated for social development in urban areas; moreover, the low price on agriculture products contributed to transferring labour and funding to state industrialization (Qu et al., 1995). The reallocation of land free of charge from the state to the work units with an indefinite period of land use rights (Ding, 2003) was a basis to develop work unit CICs.

However, similar to the Yanan-period[27], for the central government, the social poverty in post-war period weakened the government’ s ability to supply necessities to the local public (Bray, 2005). Again, benefiting from the tradition of help-oneself in local production, work units took responsibility for providing local public services including health care, education, subsidized housing, community management, job training and food subsides. To some extent, instead of the government, the work units had significant role in maintaining local social welfare system. In this process, those work units promoted state industrialization and established their independent management within respective CICs. The universities, as members of work units, cultivated huge amounts of intellectual talents for social and industrial production. Figure 6.4 shows that the CIC of Beijing University of Aeronautics and Astronautics (BUAA) integrated working and living

[27] In Yanan-period (1935-1948), the central communist government was located in the remote city Yanan, in the west of China. The organizations at the grass-roots level had to save themselves by organizing the local people into self-help productions, because during the civil war period funding was insufficient and the trade in goods had been embargoed by Kuomintang (KMT).

functions. There were assembly halls, museums, gymnasiums, playgrounds and canteens etc., where teachers and students could enjoy these leisure services without going out of campus CICs.

During the ten years of the culture revolution (1967 -1977), though there was stagnation in the production domain, the organizational structure of university CICs maintained its self-management system, including the construction of public buildings under the leading of infrastructure construction office (*基建处*) inside campus. However, enrolment decreased sharply and many professors could not continue their teaching and research during those years. The impact on the national higher education led to a huge gap between China and other countries in the cultivation of intellectual resources. Beginning in 1978, the government led by Deng Xiaoping re-opened the examination for high-education enrolment (Figure 6.2). The universities began to offer equal welfare to every student who passed the national college entrance examination. Moreover, free tuition and a grant for students relieved their families of the burden supporting them. In the same year, Deng Xiaoping declared that "Science and technology are the first productive forces", which was a key signal for promoting the national strategy of developing the country through science and education. In Figure 6.3, the huge number of national entrance exam participants during 1977 and 1978 reflected a large population aiming to enter higher education. Between 1978 and 1983, the number of students enrolling for the exam declined because the number of university-aged young people decreased. The second time the number of exam participants declined occurred between 2008 and 2012 due to on the lower number of births, a result of the one child policy. However, from 1977 to 2015, the number of students admitted increased from 270,000 to 7 million. In accordance, the overall trend of the development of the campus CICs is also upwards.

The spatial expansion of universities was resulted from providing resources for the increased number of people entering higher education. From the comparison of satellite images of Beijing University of Aeronautics and Astronautics BUAA between 1967 and 2019 (Figure 6.4 and 6.5), one measure of the space expansion by increasing the FAR can be reflected in this campus. In 1967, after 15 years of construction, BUAA had developed spatial axes about 1000 meters long from east to west, which can still be seen as a key feature of the north area in BUAA from the photo taken in 2019. Meanwhile, in the early period, another salient feature of this CIC was the existence of surrounding farmland. After the founding of the People's Republic of China, the central urban areas of many cities became crowded with a large number of residence buildings, which made it almost impossible to establish universities to replace the original urban communities in a short time. Many universities chose to construct their CICs in the suburbs where the transformation of farmland, inhabited a few number of peasants, was an easier task. Moreover, BUAA also kept land for its self-help agriculture production within the campus (BUAA, 2017).

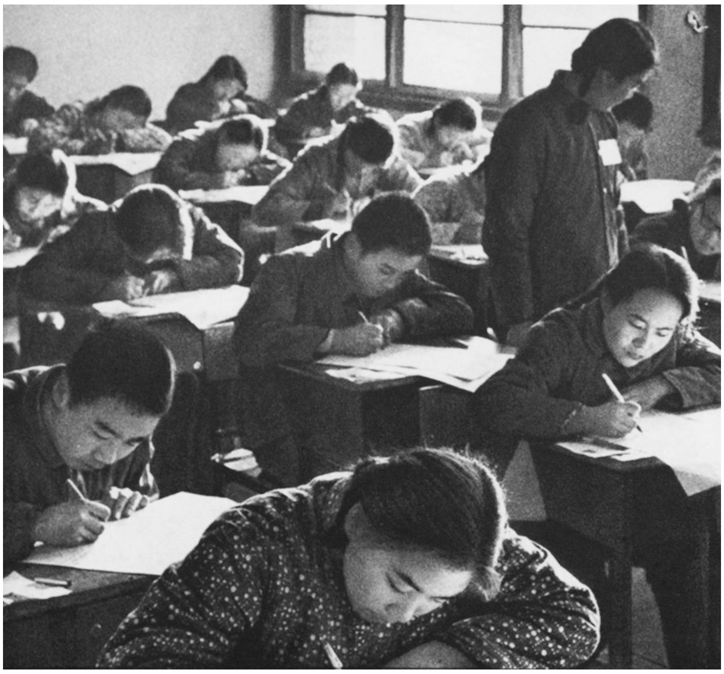


Figure 6.2. In 1977 the Chinese government resumed college entrance examinations. Photo © People's network, China. Link: http://edu.people.com.cn/GB/8216/85218/85219/6391775.html

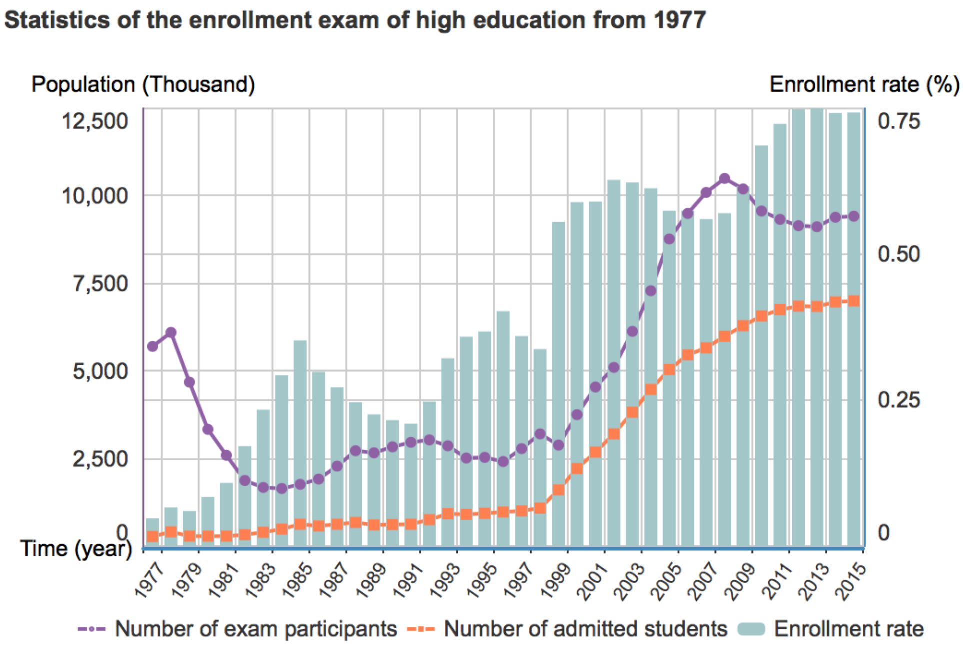


Figure 6.3. The statistics on the enrolment exam of higher education in China from 1977. Figure drawn by the author. Data source © (China, 1998-2018, Xiong, 1983, National Bureau of Statistics, 1981-2017).

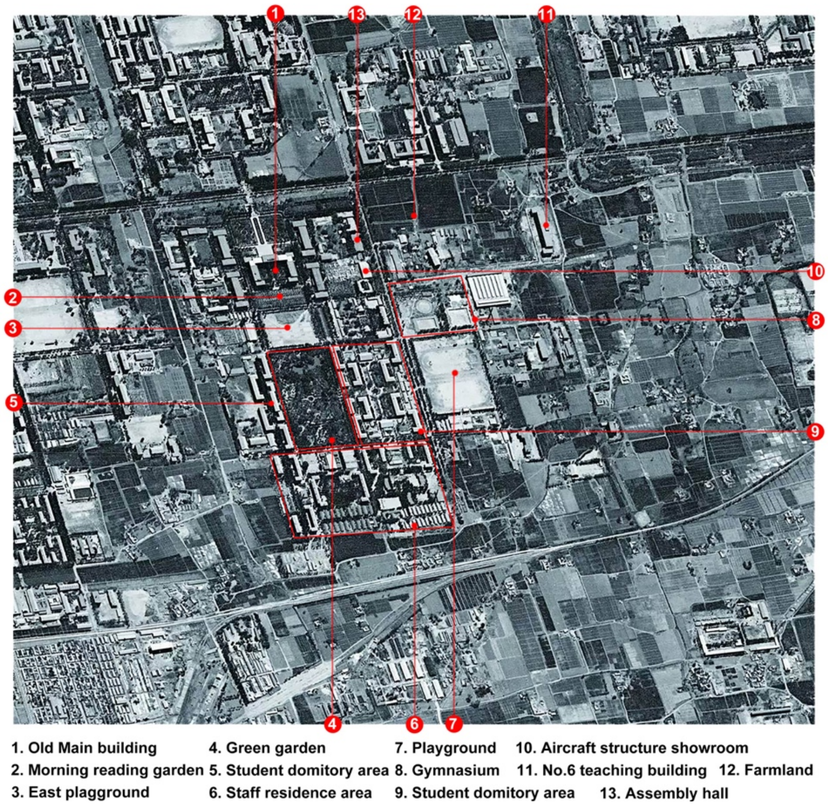


Figure 6.4. The KH-7 satellite image of BUAA in Beijing in 1967. Source © (BUAA, 2017)

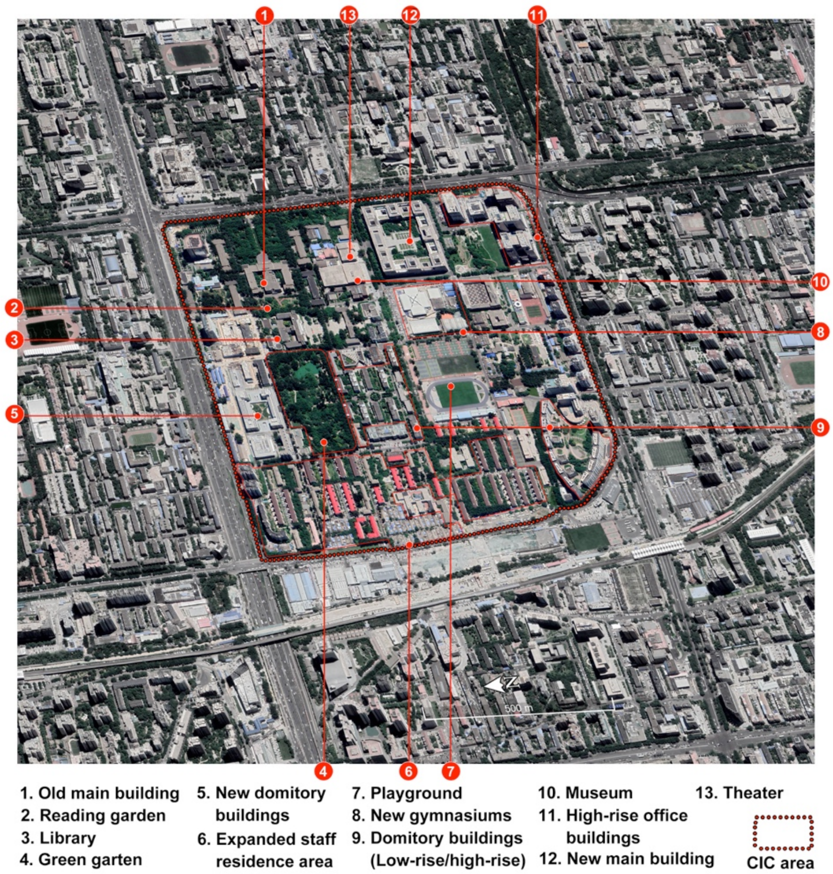


Figure 6.5. The Google satellite image of BUAA in Beijing in 2019. Adapted by the author.

• **Top-down and bottom-up oriented spatial transformations: remove or reuse old industrial buildings within enterprise CICs in the market reform after 1978**

USSR development aid assisted with the development of a secondary sector between 1953 and 1960 in China. The USSR government started the aid program called 156 Key Projects, which included technical assistance and guidance that accelerated industrial construction in China (Pantsov and Levine, 2013). Hua (2006) wrote that the Soviet urban planning experts also influenced urbanization in China. However, their primary influence was on the construction of urban infrastructure systems as well as the exploration and site-selection of industrial land. In the First Five-Year Plan from 1953, urban planning was influenced by the concepts of advocating functional zoning, paying attention to the role of monuments in urban layout, attaching importance to the greening and isolation zones, and more (Hua, 2006).

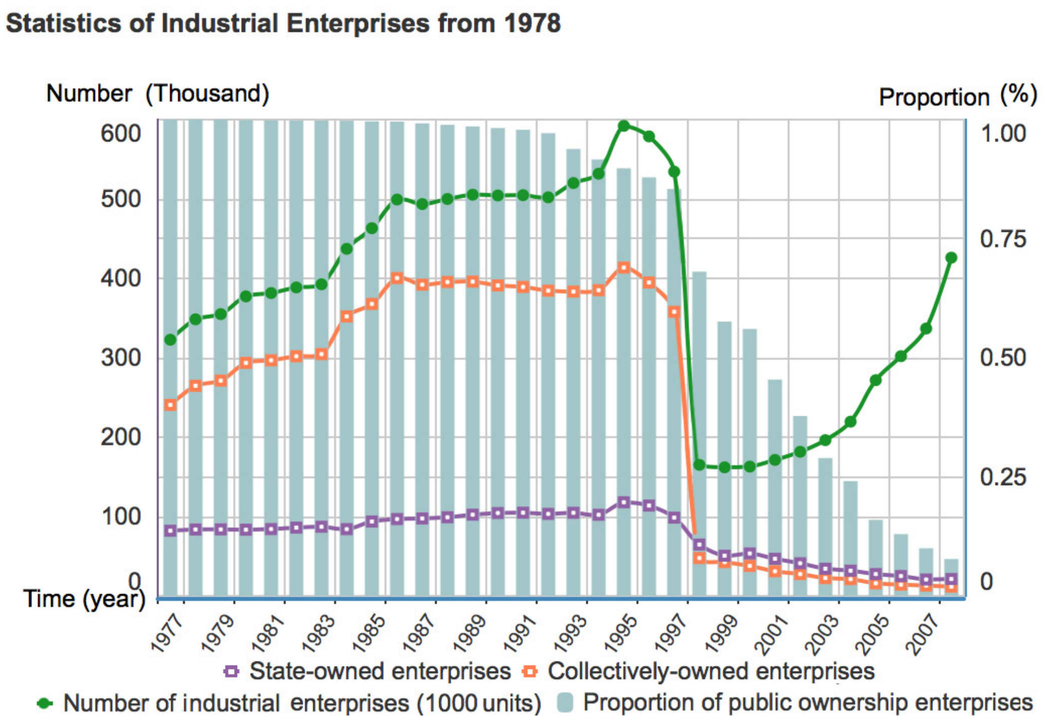


Figure 6.6. The statistics on industrial enterprises from 1978 to 2007: number of enterprises and their proportion[28]. Data source © (National Bureau of Statistics, 1981-2017). Figure drawn by author.

The state-owned or collectively-owned enterprises self-managed within their CICs and also functioned as branches or terminals of urban governance. In modern CICs, work units developed top-down oriented structures and managed according to their respective needs for different public services. Before 1978, the work units of state-owned and

[28] In China, the enterprises with public ownership mainly refer to the state-owned and collectively-owned enterprises. The data after 2007 is not included here because of the changes in the following years' statistical yearbooks, where the data on collectively-owned enterprises is merged with that of the other types of enterprises.

collectively-owned enterprises contributed not only to the industrialization but also the urbanization in China. These work units organized job, housing and other services for local neighbourhoods, which made work unit CICs function as basic urban governance units (Bray, 2005, Wu, 2005, Lu, 2006). However, in the market reform after 1978, especially in the 2000s, the original state-owned and collectively-owned enterprises suffered from the global commercial competition. The later reforms of work units (Meng, 2000, Cai, 2006) aimed to reduce the burden of enterprises, which led to a large number of laid-off workers, between 20-30 % of the workforce (Solinger, 2002). A large number of enterprises went bankrupt in the market reform starting from 1978. In Figure 6.6, the number of state-owned and collectively-owned industrial enterprises decreased rapidly but the total number of industrial enterprises grew quickly after 1994, which suggests a speedy upscaling of privately-owned enterprises in China.

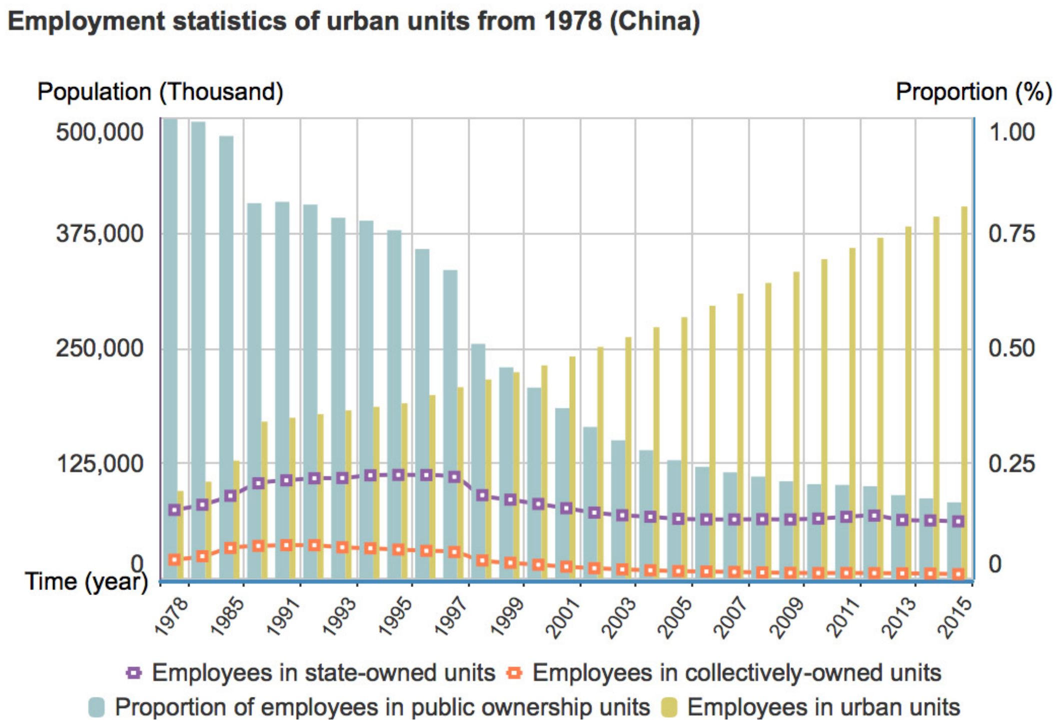


Figure 6.7. Chinese employment statistics[29] on urban units between 1978 and 2015. Data source © (National Bureau of Statistics, 1981-2017)

In Figure 6.7, the number of employees in state-owned work units rose slowly from 1978 to 1996 and then started to decrease in the following years. The number of employees in collectively-owned work units started to fall from 1992 and never rose thereafter. However, during this period, the overall number of employees in urban units increased from 29.16 million to 75.64 million, which suggests that the private companies developed in the market reform produced increased employment and absorbed more and more of the labour force. In the process as one falls and another one rises, changes also appeared

[29] Here the number of employees in publicly-owned units mainly refers to the employees in state-owned units and collectively-owned units. Table drawn by author.

in the territories of the original CICs constructed by state-owned and collectively-owned enterprises. The reform of these enterprises led to the spatial transformation of their CICs. Some were demolished due to land commercialization and others were preserved as industrial heritage parks, which constituted a differentiation in spatial transformations of CICs.

In the land commercialization of CICs in 1990s, the enterprises suffered from bankruptcy and transferred their lands to commercial projects dominated by commercial developers. The factories in the CICs and also some of the residence areas were torn down and replaced by new high-rise commercial or residential buildings. Even though the land uses in some residence areas remained unchanged due to the lack of development capital, the workers living there were removed from their original work places. The abandoned factory land became an empty resource. The socio-spatial transformation of CIC spaces can be seen in three aspects. **The first** is to construct a more permeable commercial environment with a dense road system, which could be shared by the outside public. To realize this, the original industrial buildings were demolished to prepare the land for construction. **The second** is to build gated commercial residence buildings where some of the original unit workers living there could move back or be compensated for the demolition and leave permanently. The increased floor area ratio served as the commercial return for the projects. **The third** aspect, the main aspect influencing a CIC's social structure, is the destruction of the original neighbourhood relationship integrating jobs and housing. **Finally**, state/collectively-owned enterprises and their employees were replaced by those units and employees from the private sector. Those newly built offices absorbed a large number of companies and workers. Moreover, those new commercial residences attracted buyers from different backgrounds outside the CICs. However, the individuals working there were not those who had been living there. Capital, land and labour values, pursued in the market economy (Zhang, 1997), dominated the reallocation of spatial functions and the space users in this process, which led to the socio-spatial destruction of some modern industrial CICs in China.

During this process, too, the top-down oriented land transfer and regulation on future commercial development projects led the land use to change towards market-based competition. Developers bought/obtained small pieces of land from the original CICs and increased the FAR by constructing high rise buildings and even skyscrapers. Though the CIC destruction was typically a top-down oriented land transfer, the market reform acted as the main force to urge the government and enterprises to embrace the change to stimulate the state economy.

On the other hand, the industrial preservation projects, the second transformation of CIC space use, also benefited from the industries emerging in the market. Beginning in the 1990s, there were still many urban factories in the original CIC areas that had not been transformed or even further developed. The loss of production orders created plenty of empty factories. However, the success of 798 Art District, where the industrial heritage spaces were revitalized by artists, inspired people to think about the preservation and reuse of industrial heritage buildings in China. For the first time, a bottom-up oriented transformation took place in enterprise CICs, though it was mainly because low rents and spaces of various sizes and shapes attracted new space users. The permission to convert heritage buildings was given by work unit managers according to basic security regulations, which inspired individuals from art/design studios, galleries, canteens and shops to transform the rented heritage spaces to attract more public visitors to enjoy the art and leisure space in 798.

Though the experience of 798 was partially employed in other heritage transformation projects, the bottom-up oriented transformation was not. On the other hand, 798 Art District also formed a strong top-down oriented approach to preserve and transform their industrial heritage buildings. Of the three selected industrial preservation projects in this dissertation, whether the top-down oriented transformation of Laijin and 898 or the combination of bottom-up and top-down transformations of 798, the integration of built heritage and innovative space design stressed by Gospodini (2006) contributed to the success of CIC transformations in the market reform. However, in urban areas, only a small proportion of the built industrial heritages could be preserved because most factories had been removed and transformed into commercial projects.

• Spatial stratification of enclosures and gating systems in modern CICs: government agency compounds with rigidly guarded working areas

For government agencies, many CICs are smaller than those of universities and enterprises. Moreover, the population density in government CICs is also lower than that of the other two types of work units, which might be related to the lower mobility of the population as well as less employees. In Beijing, where the campuses and factories are located far from the old town, many of the government agencies are located closer to the city centre or along Changan avenue, which is an east-west main axis. These CICs also integrated land use mix and gating systems. Though the construction and transformation of campus/enterprise CICs are emphasized in this dissertation, CICs of government agencies deserve some attention as they differ from other CICs. One is the secured enclosure-gating systems which divide the CIC into the area forbidden to visit and that which can be visited by the general public. The security checks of the gated zones in government CICs segregates the space use of those CICs, while the residence zone can be visited by the public, some office zones inside cannot.

As shown in Figure 6.8, the working area inside the CIC was guarded to prohibit the outside visit without an appointment. Government agencies as well as some highly-classified research institutions employ more rigid regulation to manage parts of their CIC spaces than in other types of CICs.

Figure 6.8. One gated working area in a government agency work unit in Chaoyang district. The guard was strictly enforcing management policies to limit visits from the general public. Outside that gate were residence areas of the work unit which the general public could freely visit. (Photo: taken by the author in November 2017.)

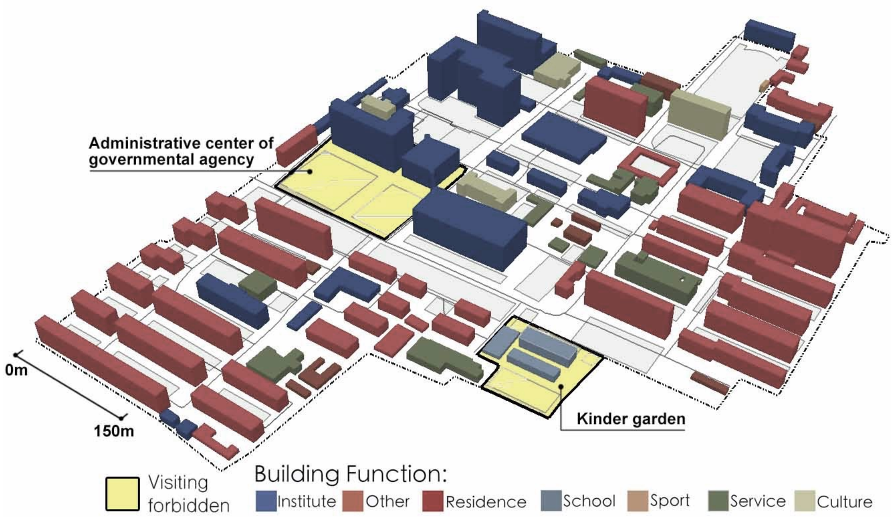


Figure 6.9. The land use mix and inside gating areas of a small CIC for the governmental agency called China Meteorological Administration (CMA) in the Hadian district of Beijing. Figure drawn by author.

CICs occupied by government agencies also maintain a high land use mix, consisting of office buildings, residence buildings, kindergartens, canteens, staff clubs, shops (markets), playgrounds (gardens) inside the CIC as well as other public service spaces located in the CIC boundary spaces. In the China Meteorological Administration CIC (see Figure 6.9), two areas are off-limits to the outside public. The larger one is occupied by government agency buildings and a buffer area. The smaller one is a kindergarten for the children of colleagues. However, all kindergartens, elementary schools and secondary schools in urban China have gating systems.

6.2 The land use mix with enclosure and gating system integrated in the space use of modern CICs

6.2.1 The enclosures surrounding and inside CICs: a tool to reduce the management cost

The enclosures of CICs are mainly constituted by walls, fences and buildings (Figure 6.10), most of which are impermeable for individuals inside and for the general public. In contrast to walls, the fences are capable to create a permeable vision between CICs and the outside public. All large CICs have also created the long enclosures, which is detrimental for constructing an integrative urban environment. However, the physical limitations of the enclosures lower costs for the spatial management of work unit CICs. Moreover, due to the spatial division produced by the CIC enclosures, the CIC inner space management and the municipal management of surroundings become independent to each other.

Though Bray (2005) wrote that the "compound wall economy" suggested the "gone" of work unit CICs, the impermeable CIC boundary buildings (only with newly transformed commercial service spaces turning outward to the public) still protects the inner modern CIC life from being interrupted by the surrounding urban public. In Figure 6.10, the enclosures constituted by buildings show different potential interactions with the outside public. The left photo on the bottom shows a negative relationship between the buildings and the outside public. The buildings with residence spaces above service spaces including shops and restaurants (the middle bottom photo) only shows the entrances of ground floor service spaces. In contrast, the entrances of above living spaces are located on the other side of the buildings. Therefore, the residents living above can only enter their apartments after passing through the gates on CIC boundaries. On the other hand, if they want to visit services of the boundary buildings facing the public, they also have to go out of their CICs first and then go around to the shops or restaurants located below. In some cases, the enclosures are too long for the residents to go out and take advantage of the services located right under them, which is why there are shops and restaurants inside CICs to provide services to CIC members. Moreover, the right bottom photo shows that the service functions fill the whole building, which is completely turned to the public, but still segregates the inside of the CIC from the public.

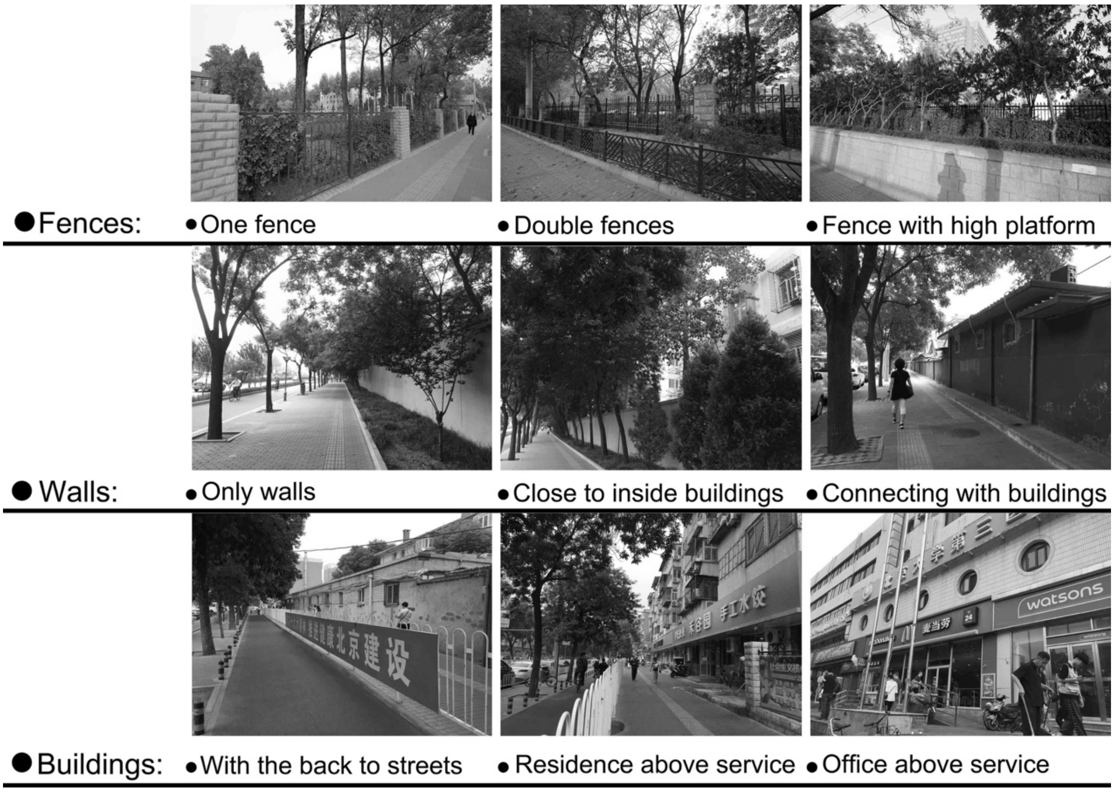


Figure 6.10. Typical CIC enclosures. Photos: taken by the author in Beijing. Resource © (Gu et al., 2019)

Individuals often prefer to sacrifice the accessibility to outside public services to promote greater security within the neighbourhood, which also decreases the cost and complexity of spatial management. Because of greater security modern CICs create complex enclosure systems along CIC boundaries. Additionally, fences and walls are also constructed within CICs to divide the inner spaces for different functional zonings. These enclosures inside CICs function primarily as spatial management while are not evidence of social segregation. In contrast to the rigidly-gated kindergartens, schools, some government agencies, most of the enclosures for residents, workers and students do not have rigid gating systems for CIC members and registered visitors. For CIC and municipal governance, social stability is guaranteed by enclosures in and surrounding CIC spaces with low cost management by reducing the number of guards. Moreover, the enclosure-gating systems in and surrounding CICs reflect the complex and flexible space use of CIC.

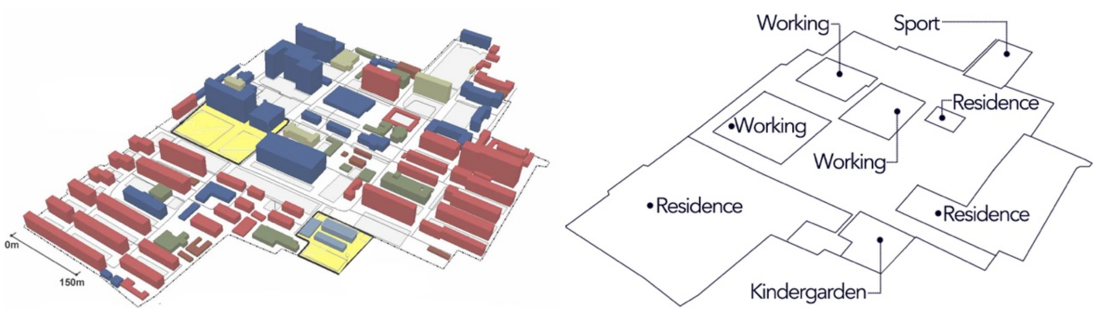


Figure 6.11. The large enclosures inside a CIC. Figure drawn by the author.

6.2.2 The fragmented CIC boundary spaces: newly produced spatial segregation?

In the market reform after 1978, the enclosures of some CICs were transformed into the outward-facing service spaces as well as visually sharable fenced landscape belts (Bray, 2005, Zhang and Chai, 2014). Moreover, some fragmented boundary spaces of modern CICs in the present day have become upgraded versions of a "compound wall economy" or a functional extension integrated with the outside public. However, similar to the early narrow service spaces on CIC borders, most of the current large-scale fragmented boundary spaces still function as "thickened walls" preventing the public from visiting CIC inner spaces. The service functions developed within these fragmented boundary spaces cater to the demands of the general public. On the other hand, these large-scale impermeable boundary spaces further promote security inside the campuses and reduce the cost of management on campus spaces.

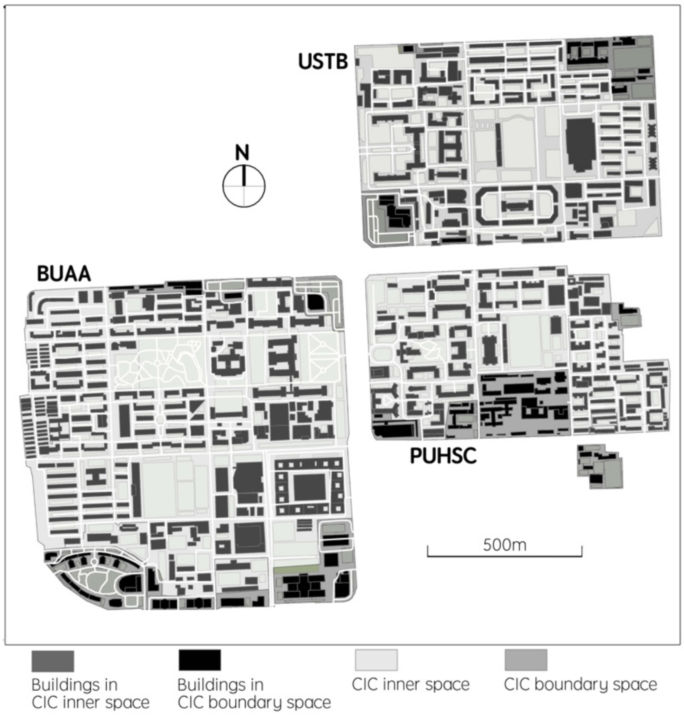


Figure 6.12. Inner spaces and fragmented boundary spaces of three university CICs. Figure drawn by the author.

In Figure 6.12, the three campus CICs all have fragmented boundary spaces. The south border of PUHSC is home to two large public hospitals and a public clinic, but the patients are forbidden to enter the campus. The student dormitory area in the southwest of BUAA is divided from the inner campus by a road with fences. Similarly, the other fragmented CIC boundary spaces of three universities are segregated from inside CIC spaces by fences and walls. The functions in fragmented boundary spaces also reflect the distinctive subject background each CIC. For example, as a medical school of Peking University, PHUSC constructed hospitals in the south boundary spaces. In contrast to the PUHSC hospitals, BUAA and USTB incorporate commercial buildings in their fragmented boundary spaces. In particular, these universities, which specialize in engineering, provide innovative engineering companies with office spaces and a knowledgeable work force. The students living and studying inside CICs also have greater opportunities to have internships nearby. Additionally, the emerging high-tech industries, commercial offices and services also absorb public work forces as well as attract public customers. BUAA even has star hotels on the boundary spaces so it can organize international congresses and generate profits for its own development. The development of fragmented CIC boundary spaces represents a special form of interaction between CICs and the public, which creates buffer areas to both segregate and integrate the public.

In contrast to the high social mix that produces an acquaintance society within CICs, the workers, customers and students from different institutes and social classes are interacted loosely in CIC boundary spaces. Therefore, the fragmented CIC boundary spaces opened to public may also risk breaching the border between the independent management of a CIC and the municipal management of the urban environments outside that CIC. To confront potentially complicated situations, customized enclosure and gating systems are developed for each fragmented CIC boundary space, which suggests a new balance of spatial governance between CICs and surrounding urban environments. Again, the walls, fences and buildings surrounding CIC boundary spaces establish the new enclosures for urban space management. In contrast to gated communities for stratified social classes, enclosures within the fragmented boundary spaces of modern CICs mainly function as a guarantee for the security at a reduced cost for management.

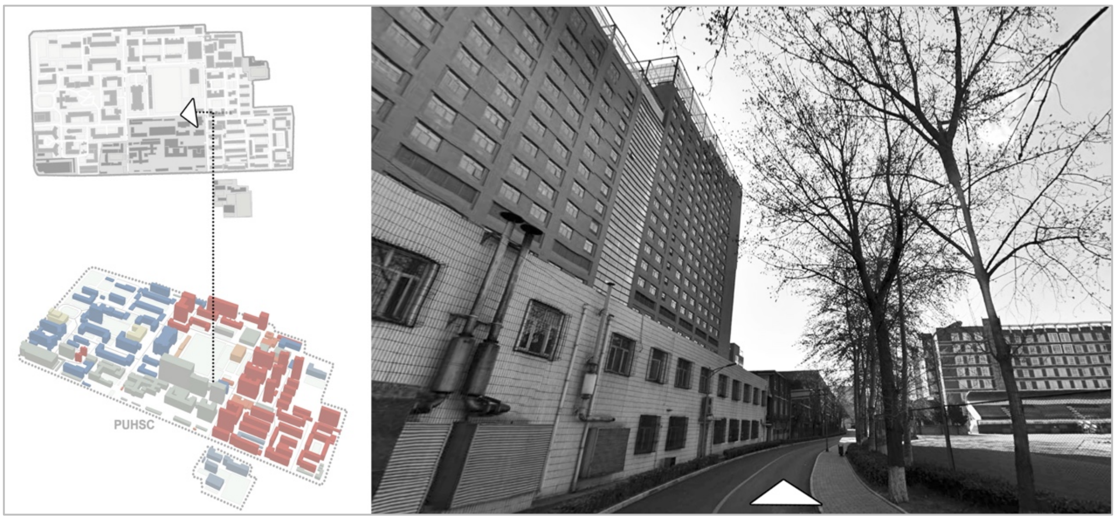


Figure 6.13. The thick “Walls” established by the fragmented boundary space of the PUHSC’s CIC[30]. Figure drawn by the author. Photo © Tencent map.

[30] In the photo, the left hospital building segregates the public individuals and forbids them from sharing the right landscape space inside the campus.

6.2.3 The ubiquitous gates and gating systems: a complex and flexible urban space management mechanism in modern CICs of Beijing

In contrast to CIC enclosures, the ubiquitous gates define the physical interactions between individuals inside CICs and those from the outside public. Due to the self-management of CICs, each work unit sets its own regulations for the gating systems in their CICs, which leads to a great variety of limitations on public visits to different CIC spaces. Figure 6.14 and table 6.1 show that the degree of integration (STID) of CIC inner areas (orange areas) of PUHSC is much lower than that of BUAA and USTB (green areas), which is the result of more rigid limitations on public visits enforced by PUHSC guards. As the location of a top medical research institute in China, the campus of PUHSC has a higher standard of security to protect the scientific research being conducted inside from being interrupted by risks from outside. The CIC inner spaces of BUAA and USTB (green areas) have a high permeability with the public outside. Due to various gating systems, the fragmented boundary spaces of one CIC may also create different spatial integration with the outside public. Fragmented boundary spaces (deep blue and light green) in three CICs with fewer limits on public visits are filled with commercial buildings. The deep red areas with strict restrictions on public visits on the borders of every CIC are home to kindergartens and schools. For PUHSC, behind a strictly-guarded gate, a middle school (deep red) is located on the other side of a public road, due to the scarcity of land for development inside the CIC. In addition, the light orange areas in the southwest of BUAA have a large number of student dormitory buildings where the public vehicles are forbidden to enter.

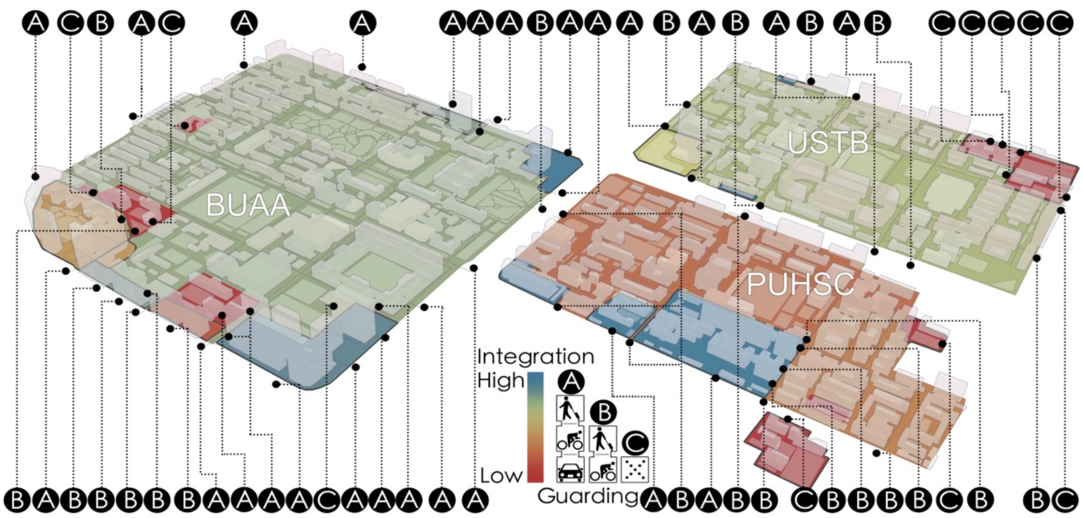


Figure 6.14. the gating management (limiting public visits) on CIC borders. Figure drawn by the author based on field observation.

STID	PUHSC	BUAA	USTB
CIC inner space	0.199	0.447	0.416
CIC boundary space	0.778	0.491	0.184

Table 6.1. the Spatiotemporal Integration Degree (STID) of CIC inner spaces and fragmented boundary spaces of three campuses in Beijing. A higher STID symbolizes fewer limits on public visits through gates.

Figure 6.15. The west gate of Tsinghua University (THU) and visitors wandering outside. Photo taken by the author in 2017.

Xu (2009a) wrote that some work unit gates regulated opening times and that some gates charged fees for public vehicles, which decreased accessibility to visit work unit spaces. The management of the gating systems in present day modern CICs is becoming more complex. **First**, the different restrictions of each gate in a CIC for work unit members and visitors reflect the complex management of CIC spaces. Because some universities are housed inside government agency CICs, not all open their campuses to the public during the day or week. Some campuses integrating renowned higher education institutes and historical/scenic sites have strict gating systems to exclude tourists. For example, the west gate of Tsinghua university has limited opening hours for public visits to maintain the order inside the campus, hence, visitors arriving outside these hours can only take photos outside the gate (Figure 6.15). The guards of east gate at Peking University require that guests register to restrict the number of people on the campus, which often leads to long queues outside the gate (Figure 6.16). In contrast, the CIC members can pass through the CIC gates by showing their campus IC card to the guards or scanning their digital cards. Moreover, some outside peasant workers providing temporary services can also enter the campuses easily with the tacit permission of the guards. Because the enclosures and gates were not always tools for social segregation and factories situated close to each other shared a residence area before 2000, sometimes it was impossible for the guards to distinguish between individuals living inside enterprise CICs and those from the outside (Wu, 2005). Currently, accompanied by the enterprise reform, most transformed factory spaces have been opened to the public, though they still have impermeable enclosures. However, a few require workers coming in to scan digital cards upon entrance to reduce chances of interruptions, though the enterprise CICs have been broken up. In Laijin cultural creative park for example, in contrast to zone A and zone B which are open to the public, zone C has a strictly-enforced gating system requiring a digital card scan for entrance (see Figure 6.54).

Figure 6.16. The east gate of Peking University (PKU) and the visitors in a long queue to wait for registration to go into the campus. Photo taken by the author in 2018.

Second, the spatiotemporal control of public visits to CICs have detailed regulations on different forms of transportation as well as prescribed time periods. As shown in Figures 6.14 and 6.17, motorized public traffic and non-motorized public traffic are differently regulated by the same guards of some gates in the same or different time periods. The middle photo in the first row of Figure 6.17 shows that public vehicles can only pass through this gate but cannot exit via the same gate, which suggests one-way streets in some areas for outside vehicles. Additionally, the time limitation on outside vehicles' visits also reveals that the night-time management of CIC spaces is stricter. The photos in the second row of Figure 6.17 shows that the regulations of some gates only permit public visits on foot or by bicycles. In the right photo on the second row, the guard ran to move the obstacle and allow the inside car to exit the CIC. The notes/signs on the obstacle illustrate the limitation on outside vehicles. For gates where only pedestrians and individuals on bicycles can pass through, the security of the inner spaces is increased, though the accessibility inside CICs is thereby reduced for the inside members and visitors. In addition, there are some gates where the public visit is forbidden due to the obligatory registration and closure (the middle and left photos on bottom of Figure 6.17). Some boundary gates are closed for all year round and only open in case of emergencies in CICs.

Finally, the flexible management of the gating system also reflects the initiative of CICs to react to public risks threatening the lives of CIC members. The gates on CIC borders react flexibly to outside public emergencies. In 2003, the outbreak of SARS (Severe Acute Respiratory Syndrome) threatened the public health of China. For high density urban campuses, to contain the spread of the virus by controlling the entering and exiting of individuals was a challenging task. Within the rigid gating systems and impermeable enclosures of CICs, many universities forbade students to leave the campuses or to return to their hometowns during the outbreak of SARS. Moreover, the land use mix inside CICs maintained research, teaching and related service functioned as usual. In normal period, benefiting from the flexible gating regulations to close the campus gates for students and teachers inside as well as for visitors, a large number of CIC members are also protected from the outside robbery and traffic accident, etc.

Figure 6.17. The gating regulations on different traffic forms of public visit to CICs. Photo taken by the author. Resource © (Gu et al., 2019)

6.2.4 The land use mix for employees living and working within CICs: the product based on independent management of collective life

In 1949, the Chinese government did not have adequate finances to fully meet the local demands for public service in urban areas (Bray, 2005). During the war and the post war rebuilding process, local people had to resume production and consumption with the assistance of local independent management. For the newly constructed work units surrounding the preindustrial towns after 1949, people situated their residence areas and working areas in close proximity within the same enclosure. Work units also had to supply public services, entertainment and sport activities to enrich workers' daily life due to the lack of support from the central government to establish the land use mix inside the earliest modern CICs. To stabilize the new political authority, the revival of social public institutes for governance, health care, entertainment and education as well as the pursuit of urban industrial development accelerated the construction of urban work units. Government agencies, universities and enterprises established CICs in enclosure-gating systems.

The land use mix in CICs even included independent coal-fired heating system for each work unit. Up to the 1970s, the industrialization of urban Beijing had produced 1700 large and medium-sized enterprises (LMEs), which built a large number of coal-fired boilers and chimneys (Xu, 2019b, Xu, 2019a). The resulting air pollution also impacted the city. Benefiting from the transformation of the urban secondary industries into third industries in the market economy, the government removed and reformed many work unit infrastructures polluting the air. The preparations for the 2008 Olympic Games also improved the urban eco-environment in Beijing. However, after 2008, the air pollution in Beijing gradually began to worsen again. In this time, without tremendous chimneys in those enterprises which was demolished in the economy reform, the remaining chimneys in the universities attracted the public's attention. In a public speech at Tsinghua university, the author of *City Memory of Beijing* (Wang, 2003a) said that Tsinghua university and Peking university were still using chimneys to release pollution into the air (see Figure 6.18), which had not been allowed by the city management. Despite the fact that the main causes of the pollution problem in Beijing was too complicated to be solved in just a few years, the critique of their universities in Beijing reflects the stable and independent land use mix in some modern CICs. In December of the same year, the director of the Beijing environmental protection bureau also gave a lecture released in THU to criticize that in the six main districts of Beijing only THU and PKU had not transformed their coal-fired boilers. Both universities quickly responded by declaring that their clean-energy transformation projects would be finished in the next few years, and they were completed as planned.

Unlike other communities which were under the direct management of the municipal administration in the capital, large CICs, such as THU and PKU, have an independent administrative jurisdiction. In some cities, the administrative level of the work unit director is even higher than the city mayor, which makes management of the CIC space by the municipal administration almost impossible. Independent management of the campus by the work unit contributed to the construction of land use mix and long enclosures in modern CICs in urban Beijing. However, in the following years after 2011 the heavy urban congestion problems would also enable the public to blame the universities again due to their impermeable enclosure systems.

In Figure 6.19, the land uses inside campus CICs for PUHSC, BUAA and USTB have been classified into 8 main functions and 26 sub-functions. Institutions for teaching and researching, residence buildings for both teachers and students, schools for the children of teachers, different public services, sport and culture facilities are situated inside the campuses. Almost all public services can be found in these CICs. The service functions include supermarkets, small shops, canteens, cafes, specialty restaurants, hospitals, banks, post offices, public security offices and staff clubs. There is a story in Tsinghua University that a doctoral student who was born there had spent his entire life on the campus, going to kindergarten, primary school, middle school and university there.

Figure 6.18. The chimney at Tsinghua University. Photo taken by the author on 20th September, 2011.

The education policy (college tuition reform[31]) established the basis for expanding the scale of university enrolment (with the gross-enrolment rate jumping from 9.8% in 1998 to 23.3%. Simultaneously, public financial support from the national government also aided universities to improve education quality. The independent jurisdiction of CICs parallel to the municipal governance supported universities in developing solid self-management within CICs. The above strategies further contributed to the construction of different land uses according to specific needs of each university.

[31] According to the policy *The Reform and Development Outline of Education in China 中国教育改革和发展纲要*[1994]39, the reform started in 1994 abandoned the double-track college entrance exams (the co-exist of: 1. the fair competition exam for high education with low tuition; 2. the purchase of the qualification for enrolment with much more money.). From then on, all the students must accept the fair examination and all the admitted ones also needed to submit the same college tuition. Simultaneously, the government implemented a series of policies to fund the poor students who were excellent in their studies.

Figure 6.19, The internal land use mix of three university CICs. Resource © (Gu et al., 2019)

Moreover, collective life inside, based on self-controlled land use mix, also supports the students and teachers with low rents and other affordable amenities. For example, the dormitory rents for every Chinese student in any public university in Beijing is limited to 1500 RMB (about 200 Euro) per semester. The financial subsidies to the canteens on campus CICs also contribute to the low prices and high quality of three daily meals throughout the year (including Spring Festival) for students and teachers.

Figure 6.20 reflects the land use mix of each CIC is based on inner functional zoning plan as well as on the construction of independent campus within enclosures separated by public roads. The eight main functions in three campus CICs have been assigned different colours. **First**, the inner spaces of these CICs have a high land use mix with clear functional zones dividing residence and working areas (see Table 6.2). **Second**, the working areas (the blue buildings) and residential areas (red) occupy large spaces and other functions are scattered between them. To ensure greater accessibility, the services, cultural and sporting activities are mainly located close to the centre of each sub-zone as well as between the residential and office areas. **Third**, the office areas in the campuses are located near each other; however, they are separated by the wide urban vehicle lanes, which also weakens the accessibility between different campuses. Except for the functions on the fragmented boundary spaces integrated with the public, the land use mix inside CICs mainly supports an enclosed job-housing balance for students and teachers within each CIC.

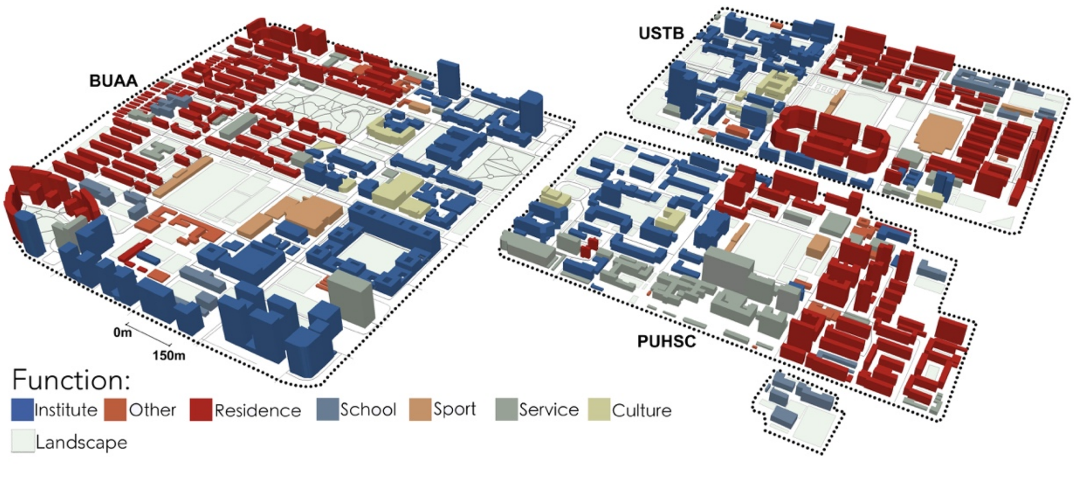


Figure 6.20. The locations of eight main functions including the landscape function and seven building functions in three CICs.

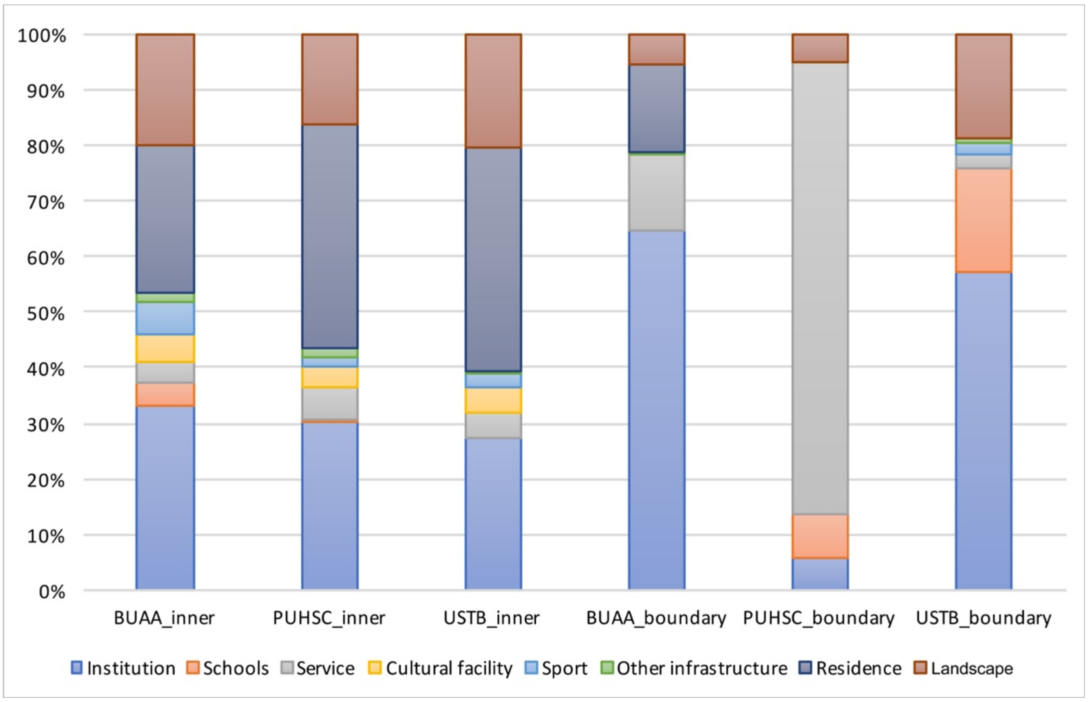
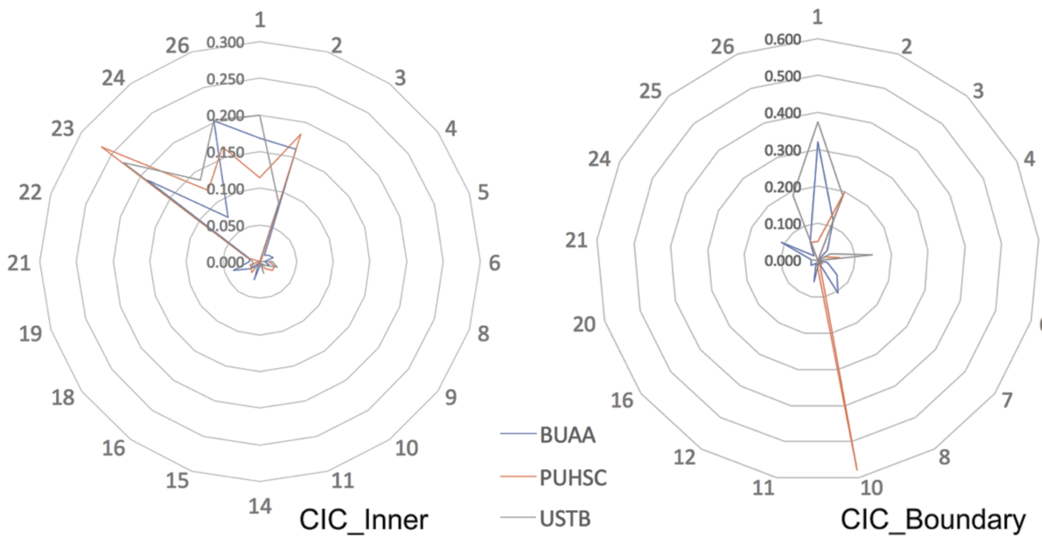


Figure 6.21. Land-use distribution of 8 main functions among inner and fragmented boundary space of BUAA, PUHSC and USTB. Resource © (Gu et al., 2019)



1. Office	10. Hospital	19. Gym for ball game
2. Teaching/Research	11. Bank	20. Gym for aquatic
3. Kindergarten	12. Post office	21. Health club
4. Primary. school	13. Public security	22. Other infrastructure
5. Junior/Senior middle school (a)	14. Theater and cinema	23. Staff dormitory
6. Market and Shops	15. Museum(a) and Gallery(b)	24. Student dormitory
7. Hotel	16. Conference hall	25. Commercial and residential building
8. Canteen(a), Café(b) and Restaurant(c)	18. Library	26. Landscape
9. Service center(a) and Stuff club(b)		

Figure 6.22. The distribution of specific 26 land uses in the inner and boundary spaces of BUAA, PUHSC and USTB. Figure drawn by the author.

In marked contrast to the different mixed land uses in CIC boundary spaces (see Table 4.4, Figure 6.21 and 6.22), the three university CICs have similar land use mixes on their campuses. Whether calculated with 8 main functions or 26 sub functions, the varied land uses inside these three CICs contributed to balancing job and housing for CIC members. Except for a larger proportion (more than 30%) of working areas in BUAA, the working areas for office, teaching and research in USTB and PUHSC are on a smaller scale than that of residence functions. However, compared with other functions, the residence and working areas are on a similar scale. From the illustration of 26 sub-functions in Figure 6.22, the staff dormitory buildings on the three campuses have a larger total area than that of student dormitory buildings. However, the students comprise a larger proportion of the population of campus CIC members, which suggests a much higher density in student dormitory areas at the night.

In Figure 6.21 and 6.22, the different land use mix in fragmented boundary spaces reflects the different features of functional integration of CIC spaces with the surrounding urban environments. BUAA and USTB have large working areas, which is due to the science and engineering specialization of both universities. In contrast, PUHSC has a large service area. The medical research and practice demands of PUHSC also prompted the construction of hospitals on its borders. Some professors and students on the PUHSC campus work in these hospitals as doctors and interns. Though the fragmented CIC boundary spaces also have enclosures, compared with CIC inner spaces the smaller scale of boundary spaces and their greater openness increase the accessibility for the public.

	Inner space			***Boundary space***		
Main functions	**PUHSC**	**BUAA**	**USTB**	**PUHSC**	**BUAA**	**USTB**
Number of land uses	8	8	7	5	5	6
Entropy	0.710	0.806	0.650	0.270	0.395	0.488
Sub-functions	**PUHSC**	**BUAA**	**USTB**	**PUHSC**	**BUAA**	**USTB**
Number of land uses	18	22	19	11	18	11
Entropy	0.729	0.739	0.714	0.574	0.786	0.704

Table 6.2. Entropy value (land use mixture) of each CIC community. The entropy of boundary space is calculated based on the total area of fragmented boundary spaces. Figure drawn by the author.

In table 6.2, the entropy values of land use mix between 8 main functions and 26 specific (sub) functions for CIC inner spaces have similar comparison outcome for three study cases. BUAA has a higher entropy than the other two and USTB has the lowest entropy among the three. In contrast, the land use mix of boundary spaces of the three cases differs when calculating 8 main functions and 26 specific functions. Because the boundary space in table 6.2 is constituted of fragmented spaces (see Figure 6.12), the entropy model is employed to calculate the land use mix for the total area of the boundary spaces of each CIC, which excludes the influence of spatial discontinuity on the accuracy of the model.

6.3 The space use mechanisms in urban campuses in a modern CIC cluster area in Beijing

6.3.1 Modern CICs thriving due to the development of local universities

At present in China, there are six cities, each of them is home of at least five of the top universities in the country. Moreover, the universities are located closely to each other within each city, which led to CIC cluster areas during the time of planned economy, between 1949 and 1978, as well as in market reform after 2000. In contrast to state-owned enterprises, these universities did not suffer from the bankruptcy or experience the transformation of large-scale land into commercial communities. They developed and even expanded their campuses with a number of measures. Some campuses expanded their territories to the other side of nearby urban public roads. Therefore, the development of campuses surrounded by built urban areas tends to stabilize CIC cluster areas, which suggests a support from governmental policies in promoting higher-education industry. On the other hand, some universities are currently obtaining land in distant peripheral areas (creating university towns) to build new campuses to accommodate the increasing number of students.

Most universities build enclosures and gating systems and promote a high land use mix to manage and balance teaching work, study and residence for teachers and students. The collective consumption and production for students and teachers is typical of modern Chinese CICs. In 2017, there were 1243 universities and colleges where undergraduate students enrolled in. About 4.107 million students passed the national undergraduate enrolment examination and 850,000 students passed the graduate entrance examination in 2017. There were 16.486 million undergraduate students and 2.73 million graduate students studying in universities (Ministry of Education of the People' s Republic of China and Ministry of Human Resources and Social Security, 2018). In Beijing alone, there were 92 universities and 127,000 undergraduate students as well as 104,000 postgraduate students were enrolled in 2017 (Beijing Municipal Education Commission, 2018). In China, to promote high quality research and teaching in higher education, the government established Project 985, Project 211 and the Double First-class Project to create a competition to select and fund the best universities. 112 universities were selected for Project 211, 39 universities were selected for Project 985, and 42 universities were selected for the Double First-class Project. Almost all the universities in Project 985 and the Double First-class Project also in the Project 211. In Beijing, there are 26 universities which belong to the three projects mentioned above (see Figure 6.23 and Figure 6.24). The large number of top universities makes Beijing a city for getting an extraordinary attention not only in higher education but also in the existing typical CIC cluster life style in Chinese megacities with dense population.

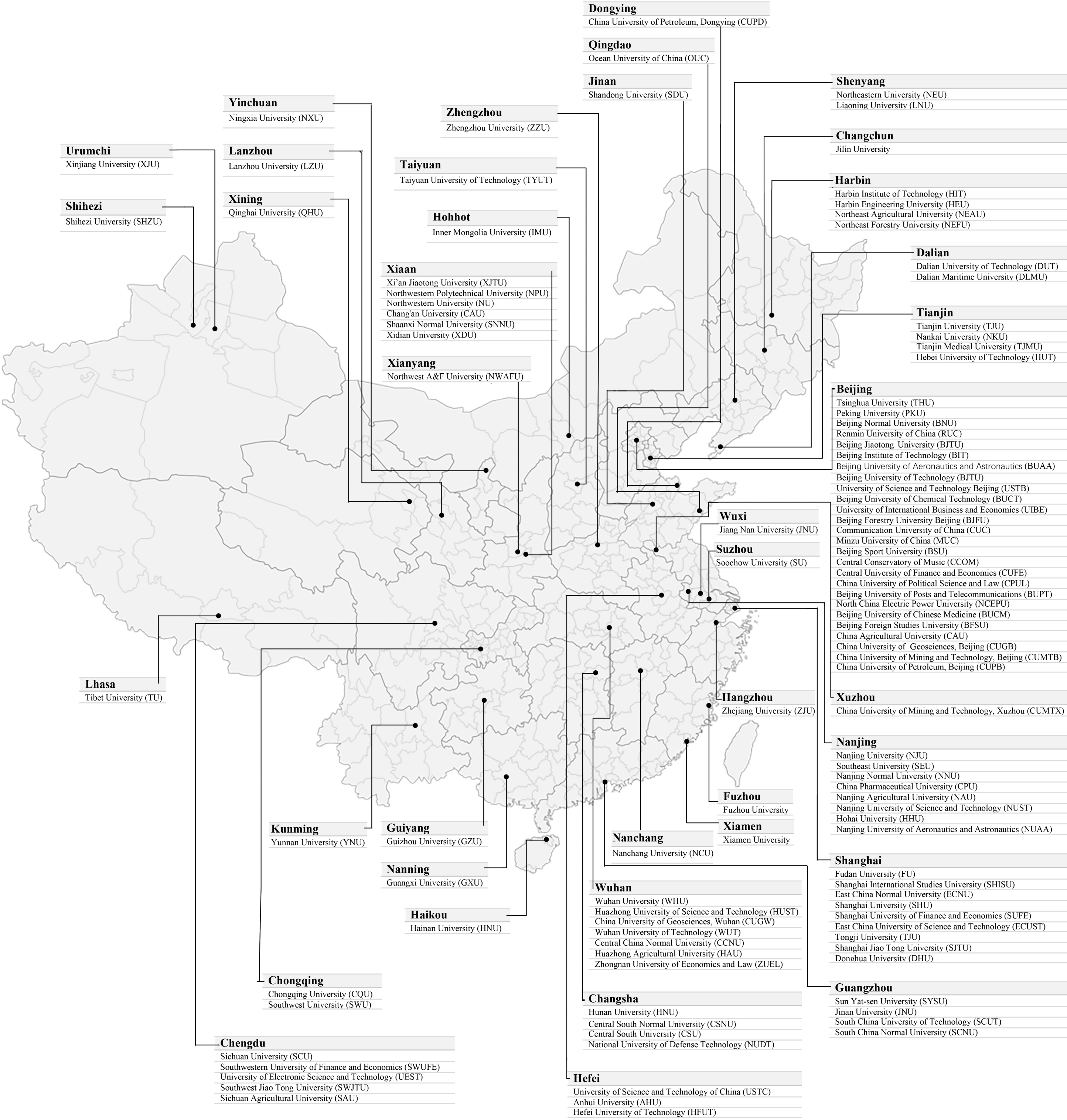


Figure 6.23. The distribution of the universities in Project 985, Project 211 and Double First-class Project in China. Figure drawn by the author.

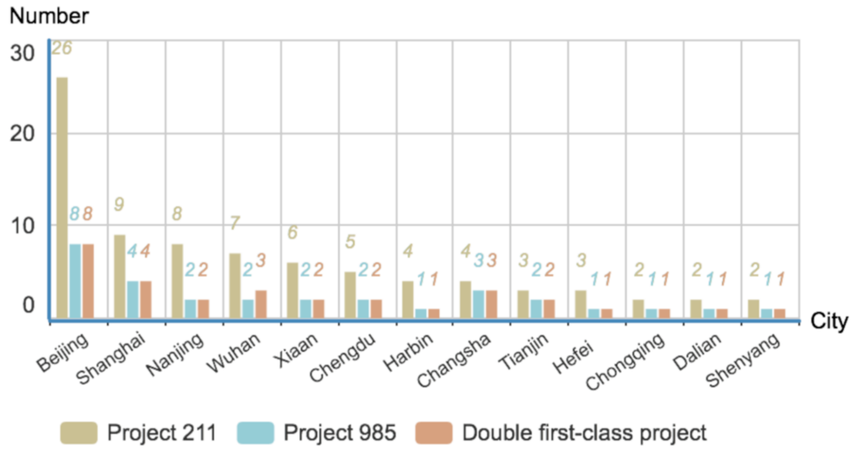


Figure 6.24. The cities which have more than one "Project 211" university. Figure drawn by the author. Data source © (Ministry of Education of the People' s Republic of China and Development Planning Division, 2017)

For example, the central urban areas of Nanjing contain more than 15 campuses located nearby Xuanwu lake and another 10 campuses are located in Nanjing Xianlin University City to the east of Nanjing east train station. The campuses are situated closely to each other in each CIC cluster area. In the south peripheral areas of Nanjing, more than 13 recently built campuses, 10 of which are located in Nanjing Jiangning University Town near the east of Fangshan mountain, a scenic spot. Other campuses can be found in Nanjing Pukou University Town on the other side of Yangtze river. Though among above universities and colleges there are only eight "Project 985" universities and two "Double first-class project" universities, the extant 4 CIC cluster areas with one in urban centre and another three peripheral areas revealed the continuity of modern CIC lives in Nanjing. Moreover, in other big cities including Beijing, Xian, Wuhan and Shanghai, etc., the existence of CIC cluster areas in urban areas is a prominent phenomenon.

The good financial situation for promoting the development of campus CICs is prominent in Beijing. As shown in figure 6.23 and 6.24, Beijing has almost 1/4 of the "Project 211" universities. Eight "Double First-class Project" universities are in Beijing and they are all within the same CIC cluster area in Haidian district. To some extent, the top universities in Beijing also have more revenue than universities in other regions. For example, the annual budgetary revenues of Tsinghua University (THU), Peking University (PKU) and Beijing Normal University (BNU) in 2019 were 29.72, 19.01 and 8.19 billion RMB, which cannot be matched by the top three universities in Nanjing (Nanjing University: 7.75 billion RMB, Southeast University: 7.47 billion RMB, Hohai University: 3.85 billion RMB). Additionally, in Beijing there were another two top universities (BUAA and BIT) which did not release information on revenue and expenditure in 2019. Due to the importance of these two universities in military industrial research, their revenue from engineering industry as well as financial supports from the central government maybe close to PKU and higher than BNU. The fiscal superiority of universities in Beijing suggests one reason for the booming of CIC cluster in there.

6.3.2 The space scarcity in large dense campus CICs: high densities of working and living populations in urban Beijing

The higher education reform started in 1994 led to a boom in the number of enrolled students in Beijing. In 1999, the Chinese Ministry of Education implemented a new policy called "*The action plan for educational revitalization facing the 21st century*" to expand the number of enrolments at universities. As can be seen in figure 6-25, the population of university students in Beijing soared from 234,030 in 1999 to 577,150 in 2009. Between 2009 and 2012, the government began to limit the number of new enrolments so that the number remained a stable level. Following the above increase in the number of enrolled students between 1997 and 2006, the number of graduating students also rose quickly from 2000 and in 2009 their population was about 150,000 people. In contrast to the rapid rise in the student population, the number of higher-education institutes grew slowly. Though the student population remained stable after 2009, the large population has challenged the capability of university CICs to accommodate them.

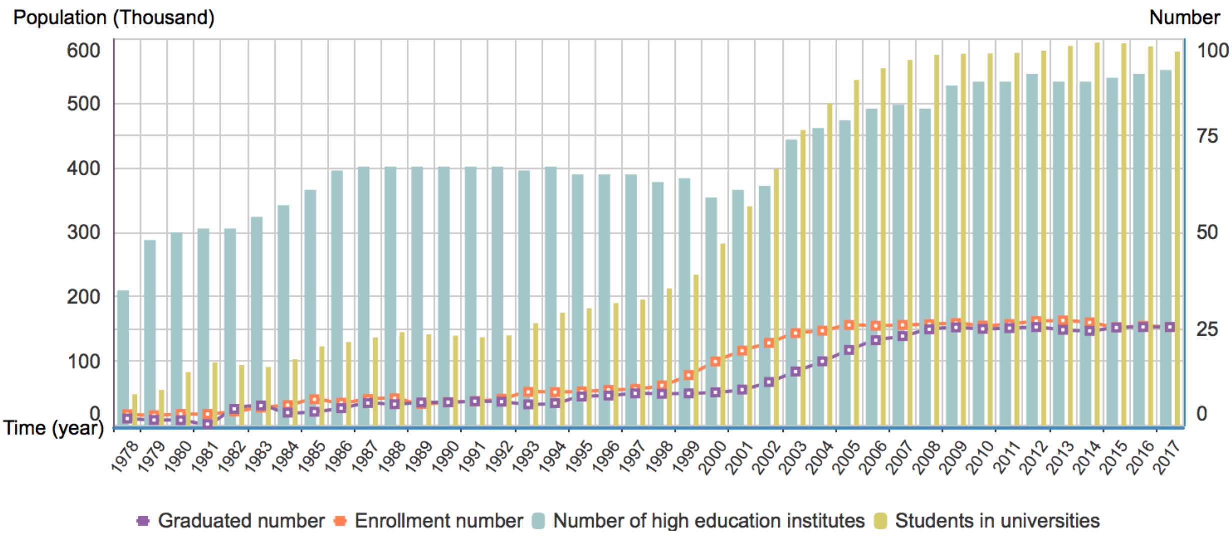


Figure 6.25. Statistics of urban higher-education development in Beijing. The "enrolment number" is the number of newly enrolled students for each year. Figure drawn by the author. Data source © (Beijing Municipal Education Commission, 2018)

Since 1990s, many teachers have been retired and lived with their families on the campus CICs. Even though some teachers bought new apartments in commercial residence communities outside campus CICs, they can rent the housing inside campuses to anybody, which weakened the ability of work units to distribute residence spaces in CICs to people working/studying here. Moreover, new teachers and scholars are recruited to meet the increasing demands of teaching and researching tasks, and the lack of residences on campuses for young teachers has become a challenge to maintain the job-housing balance inside CICs. Similarly, the increasing number of students and scholars also demand more infrastructure for public services. The lack of new teaching/office buildings, laboratories as well as service/culture/sport buildings reveals the need for vertical and horizontal expansion of CIC spaces.

In Beijing, to resolve the problem of space scarcity, universities experienced spatial expansions far away from outside their CICs. Some universities built second or third campuses in suburban university towns close to the sixth ring of Beijing. These university towns are far away from the campuses inside fifth ring road. Beijing is home to two important university towns, one is located in the north west (Shahe in Changping district) and the other is located in the south west (Liangxiang in Fangshan district). Each has six or seven large campuses for different universities. The mixed land uses within these suburban campuses have no significant difference with campus CICs inside fifth ring. Using public transportation to travel between two campuses inside and outside Beijing's fifth ring for each university takes about one or two hours. High traffic congestion during the commute can extend these times. However, the distant locations on urban periphery areas reduces the cost of purchasing land, which contributed to constructing large new campuses in Liangxiang University Town and Shahe Higher Education Park. In the newly-built campuses, the life, job and studying for students and some teachers is rebalanced again, though students always complain that they lost the convenience of being integrated into the rich central urban life.

In contrast, the campuses surrounded by modern urban areas within the fifth ring road expanded their spaces in two directions: vertical growth in CICs to create a higher FAR ratio as well as horizontal expansion to integrate the urban environments surrounding CICs. **First**, in campus CICs more teaching/research buildings, residence buildings as well as other service and sport buildings were built to increase the floor area ratio (FAR). THU, for example, benefited from being locating in a large CIC with 3.28 km^2, to provide students and teachers with a place to study, work and live inside the CIC. Three large new library buildings were planned to be built after 2010 to meet the increasing needs and the construction for two of them has been finished. New research buildings for science and engineering as well as international cooperation have also been constructed in recent years. Almost all the THU students in Beijing study on the same campus. Moreover, the young scholars and teachers there can also apply to live on the campus. **Second**, to resolve the problem of retired teachers occupying campus housing and the lack of residences for new teachers and scholars, THU established a new gated residence community (Bajia) to the north, outside the CIC for exchanging the campus houses of retired colleagues to create more living spaces for colleagues working inside. **Third**, some universities moved the working and living spaces for teachers and students to the other side of the urban public roads surrounding the CICs. For example, PKU constructed buildings for research, student dormitory, staff apartment, kindergartens, primary schools, secondary schools, staff clubs, canteens, hospitals, restaurants, hotels as well as shops on the other sides of the east and west urban roads surrounding the central CIC of PKU, which relieved the burden of the CIC by distributing the teachers and student outside. The central campus CIC of PKU is only about 1.17 km^2; however, the total scale of three surrounding outside extension areas (West area: 0.27 km^2; Northwest area: 0.21 km^2; Southwest area: 0.14 km^2.) is about 0.62 km^2. Even though the extended areas are separated from the central CIC by roads, they relieved the land shortage issue. In addition, their location, close to the central campus as well as the connection by overpasses, means that the people who live there have only a short commute.

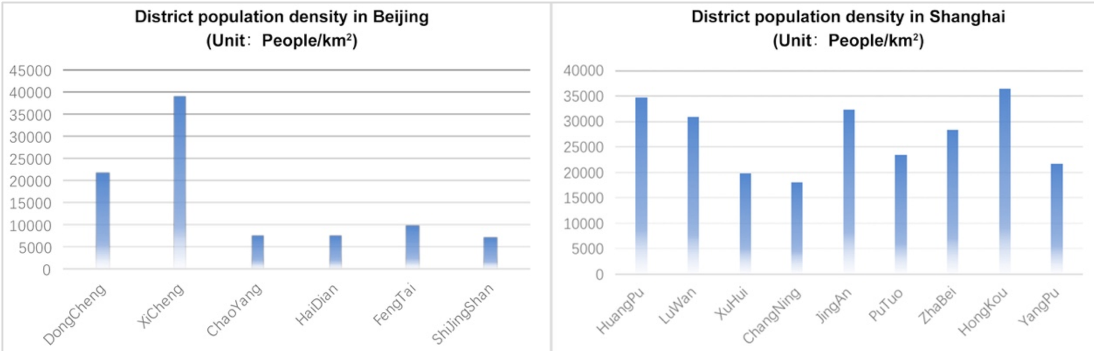


Figure 6.26, The population density of main districts in Beijing and Shanghai. Figure drawn by the author. Data source © Sixth National Population Census of the People's Republic of China (2010 Chinese Census) which was conducted by National Bureau of Statistics of the People's Republic of China.

However, in present day practice many universities in Beijing combine the above spatial forms of expansion for integrating adequate mixed land uses in their urban campuses, which reflects the development vitality of campus CICs surrounded by modern urban areas in Beijing. On the other hand, accompanied by self-improvement in each campus CIC, the compact locations of urban campuses in Beijing also leads to the development of CIC cluster areas with high population densities. As revealed by the heat map analysis of high-density locations in the largest CIC cluster area of Beijing, population densities inside CICs are much higher than those of the surrounding urban environments across the entire day (Figure 6.27 and Figure 6.28). In particular, the population density within the CICs is generally very high. Within the CIC cluster area shown in Figure 6.27, all CICs serve 1/3 of the living and working population even though they occupy only 1/4 of the total area. In addition, the population densities of CICs are much higher than the average population densities in the central urban districts of Beijing (9,208 people/km2) and Shanghai (24,154 people/km2). The above statistics indicate that CICs are subject to a high spatial burden produced by high population densities in contrast to neighboring urban areas. To guarantee the whole day's security of large active population inside CICs with a relatively low cost become a key task of the campus management, which encourages universities to firmly preserve the enclosure-gating systems of CICs.

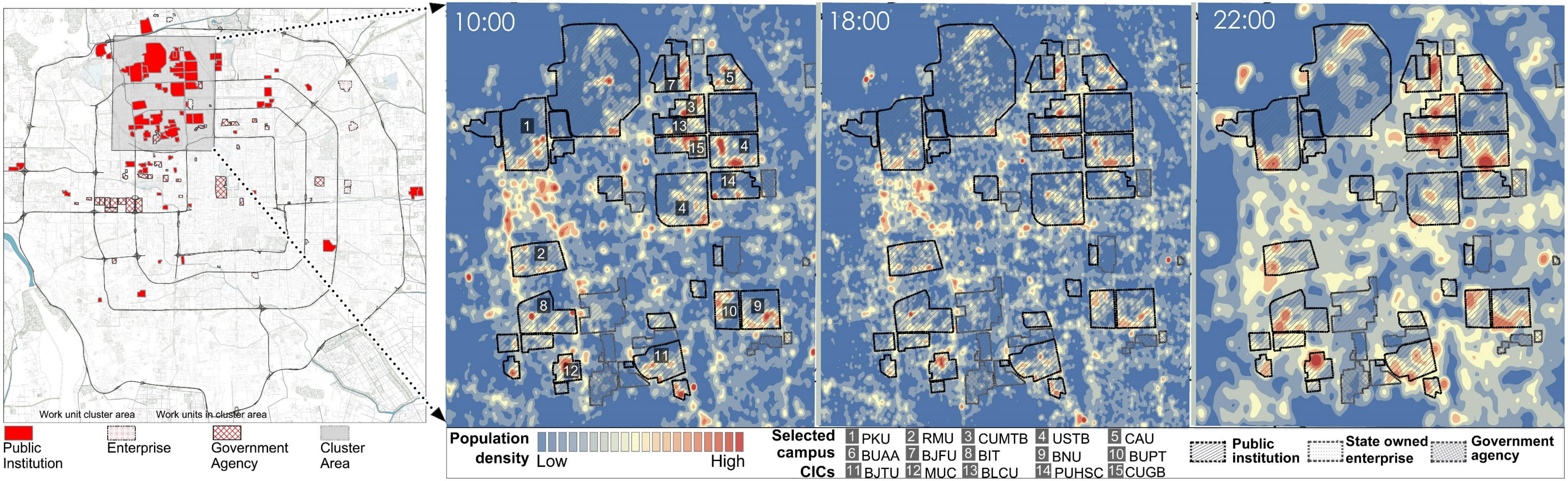


Figure 6.27. The locations of different types of modern CICs, CIC cluster, CICs inside the cluster area as well as population densities. Resource © (Gu et al., 2019)

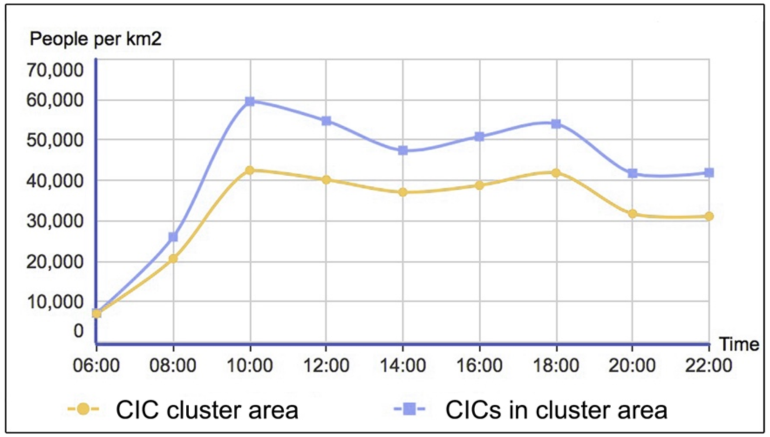


Figure 6.28. The real-time population densities of CIC cluster areas as well as CICs in cluster areas. Resource modified © (Gu et al., 2019).

6.3.3 The space use vitality in three campus CICs based on the analysis of population density, land use mix and the enclosure-gating system

Montgomery (1998) wrote: " By having people on the streets, in the cafes and moving through the public realm, urban vitality is stimulated." Rowley (1996) summarized four 'indispensable' points in maintaining the space use vitality:" mixed use, fine grain, high density and permeability" (Sternberg, 2000).

The campuses in Beijing have high land use mix (high entropy value based on the analysis with model 3 in chapter 4) and high population densities, which has suggested the vitality within campuses of Beijing. However, to examine the high vitality based on the real human actions in urban spaces, new indicators were developed based on the heat map analysis of population densities (Gu et al., 2019). The land use mix and areas with high population densities were overlapped to estimate the real-time space use vitality in campus CICs. Even though the campus CICs have higher population densities than the surrounding urban environments, the land use vitalities inside each CICs are very different in different hours and zones, which has also been examined in this dissertation to uncover how CICs balance their space uses with the burden of super high population densities (close to 150,000 people per km2 during some time. See the right curve on the top in figure 6.33).

In this dissertation, through the overlap analysis of land use mix with fine granularity and specific space users with changing population densities and locations, the dynamic space use vitalities in CICs can be revealed based on the locations of high population densities in specific times. The study of vitality revealed the dynamic interaction between mixed-use spaces and space users, which is a progress in contrast to the methods based on static land use mix and residence populations in urban spaces in former studies (De Koe and Hva, 2013, Xia et al., 2020).

The specific population densities in real times and real places have been inferred in this dissertation based on the analysis of heat map data. The comparison of population densities inside CICs and that in surrounding urban areas shows that campus CICs have higher population densities, which also suggests a higher urban vitality of mixed-use spaces inside CICs. Moreover, the uncovering real time use of different land uses with different population densities contributes to analyzing the correlation between the space use vitality, land use mix as well as the enclosure-gating systems.

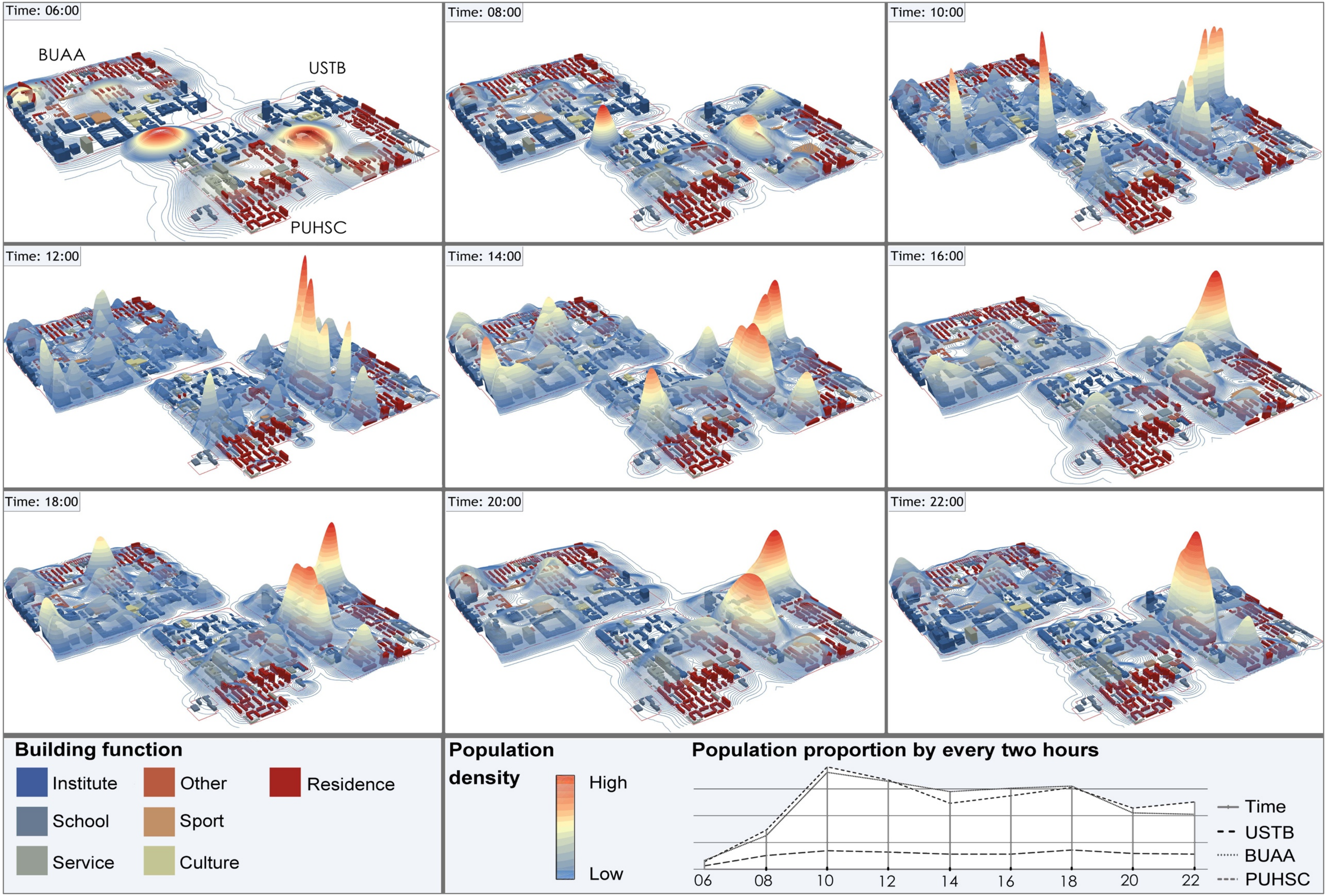


Figure 6.29. The land use mix, population density and proportion in real time for three modern CICs. Figure drawn by the author.

Since the absolute densities for three university CICs in figure 6.29 show a large discrepancy of space use vitality, each CIC must be further investigated independently with regard to the relative spatial-temporal pattern of the population density. Figures 6.29 and 6.30 show the space use vitality based on the utilization of the mixed-use spaces with high population densities across the entire day. As expected, the highest density is concentrated around the residence areas between 6:00 and 8:00. At 8:00, the residence buildings, markets and canteens have a higher density than they did at 6:00. From 8:00 to 10:00, the student residence areas still had a high population density. The density in the surrounding office buildings is highest at 10:00. The population distribution around 12:00 and 18:00 become more scattered in two of the three campuses. At 20:00, the spaces with a concentrated population appear to be much more scattered than at other times of the day. As expected, the residential buildings had more people than other areas in the CIC at 22:00. The student dormitories of the three campuses had higher densities than those of the teachers' residences, because the student buildings have a higher FAR and a more compact number of residents in dormitory rooms. Moreover, the close distance between classrooms, libraries and dormitory buildings increases the amount of time students spent in their dormitories.

In figure 6.29 and 6.30, the fragmented boundary spaces of PUHSC and BUAA have very high densities between 10:00 and 14:00, which differs from USTB. The hospitals and clinics in the south boundary spaces of PUHSC have much higher densities than that of the inner CIC spaces in the early morning, due to the large number of patients who come to wait for an early appointment. This also suggests the different level of integration of the urban public in fragmented CIC boundary spaces, as well as the functional division in social production/consumption in each CIC.

The proportion of areas with vitality in CIC inner spaces is higher than that in fragmented boundary spaces during most of the time (Figure 6.30). Moreover, based on the overlaying analysis in Figure 6.31, DMPHA data reflects the extent which the CIC spaces are stimulated by high population densities across a whole day. The USTB CIC, with the largest residence population (22:00 in figure 6.29), has the lowest DPMHA (Table 6.3). In contrast, the PUHSC CIC has the smallest area, but its DPMHA is larger than that of USTB. Further, the BUAA CIC, with the largest area, has the highest DPMVA (0.228), which suggests a more balanced distribution of mixed-use spaces in BUAA. However, none of the DPMHAs in the three CIC inner spaces is above 0.25, which indicates that these university CICs have highly concentrated populations in high-rise dormitory and classroom buildings. To some extent, this is also due to the large proportion of open space and low-rise buildings within campuses.

On the map on the right of figure 6.31, there are no clear distinctions between the floor area ratios (FARs) of the residence buildings and of office buildings. According to the field studies in BUAA, USTB and PUHSC, the old buildings for both residences and offices have lower FARs than those of the newly constructed buildings. The latterly constructed high rise buildings enable those CICs to accommodate the population growth inside the campus. On the other hand, in figure 6.31 the DPMHA mainly covered the areas with high FAR, which suggests a correlation between them. To some extent, the increase of FAR is in accordance with the promotion of land use mix in a campus CIC.

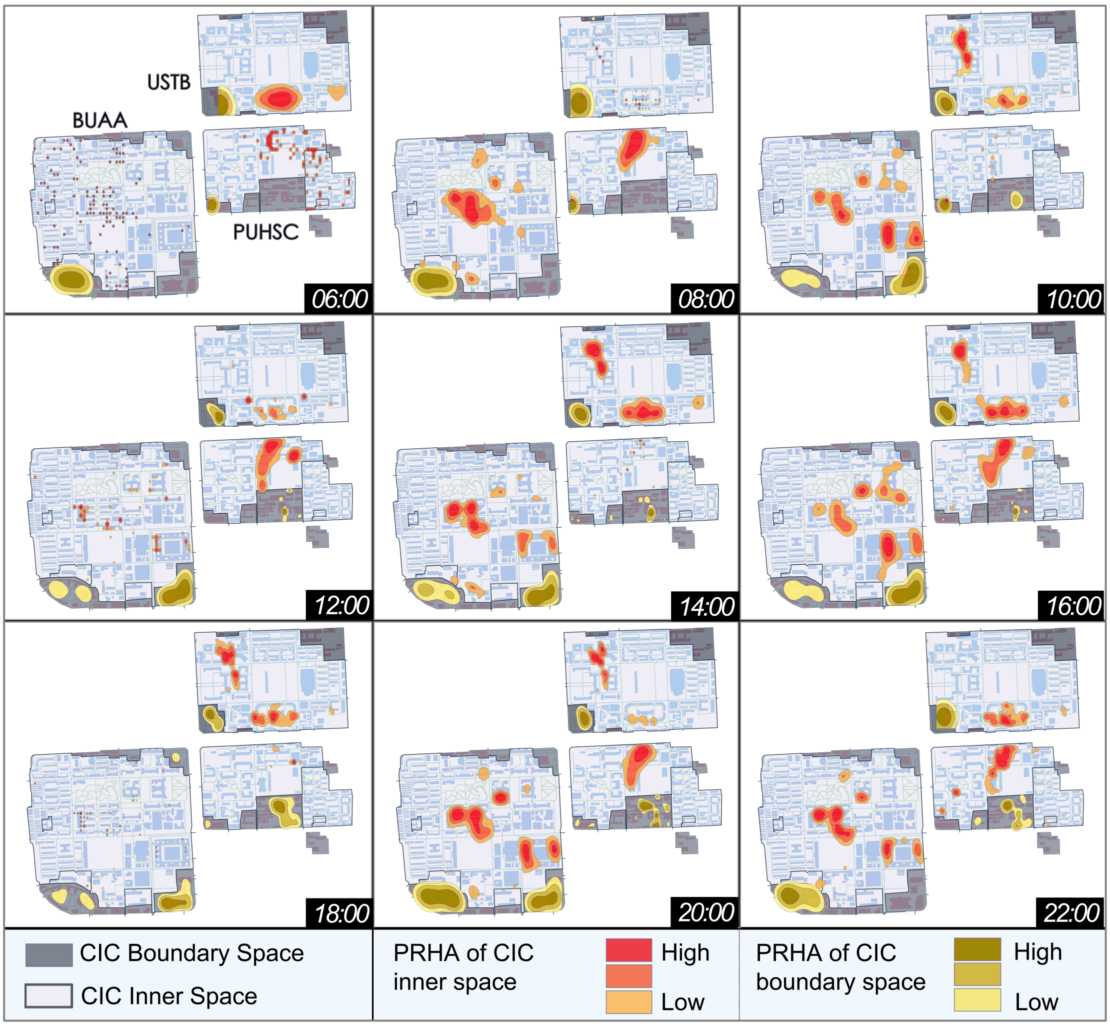


Figure. 6.30. Areas with high space use vitality in specific times within campus CICs based on the heat map analysis. The land uses are classified into 7 degrees with different population densities and the top three degrees (proportion of real-time high-density area: PRHA) have selected to identify the areas with high space use vitality within CICs.

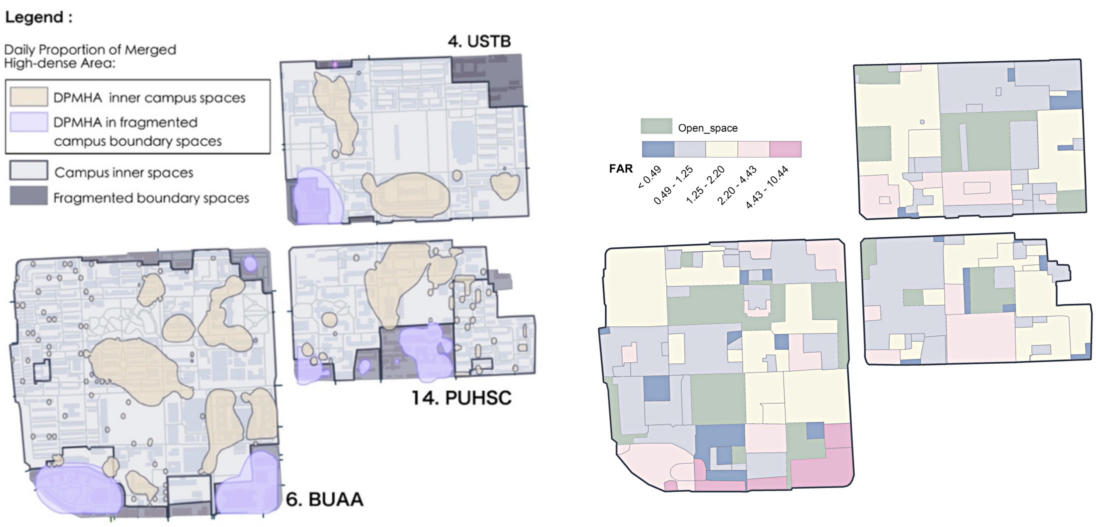


Figure 6.31. Left: Space use balance based on daily proportion of merged high-density area (DPMHA). Right: Floor area ratio (FAR). Resource © (Gu et al., 2019).

	Inner space			***Boundary space***		
Campus CIC	**PUHSC**	**BUAA**	**USTB**	**PUHSC**	**BUAA**	**USTB**
DPMHA	0.226	0.228	0.163	0.445	0.672	0.455
Land use mix *(Entropy)*	0.710	0.806	0.650	0.270	0.395	0.488
Spatial integration *(STID)*	0.199	0.447	0.416	0.778	0.491	0.184

Table 6.3. The DPMHA (Daily proportion of merged high-density areas), Land use mix (entropy) and STID (Spatial-temporal integration degree) of three campus CICs. Figure drawn by the author.

In table 6.3, the daily proportion of merged high-density areas (DPMHA) of the three campuses are correlated with the entropy data for each CIC. The high land use mix in these campus CICs contributes to the space use vitality. Moreover, a higher land use mix also contributes to a more balanced distribution of population within the CIC. In contrast, there is no clear correlation between the STID degrees and the space use vitalities of the CICs. However, the influence of enclosure-gating systems in CICs cannot be ignored because the STID degree mainly reflects the level of openness of CICs to surrounding public. In contrast, the enclosure (accessibilities) degree based on the calculation of CIC scale and number of gates should also be considered for members living and working inside CICs (see formula 7 in chapter 4). For the large number of CIC members, the large-scale enclosures also protect the inside high space use vitality from being interrupted by the outside public, which may be hard to observe in a simple correlation analysis based on DPMHA degree.

In contrast to the CIC inner spaces, the correlation between DPMHA and land use mix in the fragmented boundary spaces is not very clear in Figure 6.31 and Table 6.3, which suggests, based on highly differentiated land use compositions and an integration of CIC members and public individuals, the spatial discontinuity and the small scales of fragmented boundary spaces lead to a high inhomogeneity in space use. However, though inner spaces have higher land use mixes than the fragmented boundary spaces, the DPMHA of inner spaces is lower than that of the boundary spaces. This demonstrates that the boundary spaces are more fully used though not all of them have higher densities than the inner spaces. Therefore, the higher DPMHA in boundary spaces also reveals a more balanced space use because a higher proportion of boundary spaces has been utilized by dense people during the day. In contrast, due to the smaller difference between population densities in CICs of working hours (10 am) and free-time (10 pm) in figure 6.32, the CIC inner spaces have a higher job-housing balance than the fragmented boundary spaces.

Figure 6.32 shows the population densities of inner and boundary spaces in each CIC as well as the proportion of high-density areas (PRHA) during the same time. The total population or population density is not a constant value across 24 hours a day since CICs are not completely enclosed entities (as mentioned in the STID section). Hence, it is necessary to focus on the correlation between population density and PRHA to obtain a better understanding of the importance of the land use mix to the balanced usage of areas (balanced distribution of the population), which might reflect the vitality of mixed-use spaces.

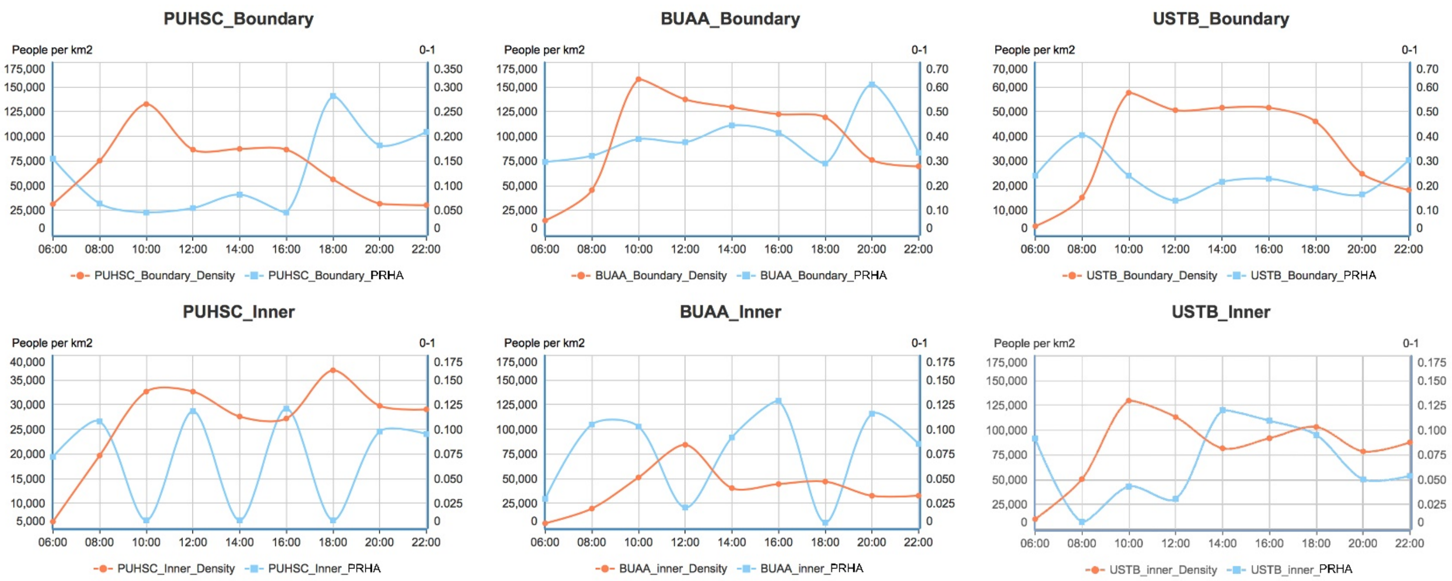


Figure 6.32. Population density and PRHA in real time. Figure drawn by the author.

The period between 16:00 and 18:00 represents for many people the transformation primarily work activities to service activities. Combined with the analysis from Figure 6.30 and Figure 6.32, I focus on this period to examine how the correlation between dynamic population density and dynamic PRHA varies among different levels of land use mixture to reveal the land use balance in CICs. Figure 6.32 shows that with the population increase, the PRHA of both PUHSC and BUAA decreased sharply while the PRHA of USTB decreased only slightly, which reflects that the land use mix inside CICs play a positive role in balance different types of space uses in service time. Combined with the different entropy values of the inner spaces of the three CICs (Table 6.3), the relatively larger land use mix for PUHSC and BUAA might indicate a sufficient supply of a variety of service facilities across the space that attract and redistribute the population into spaces with different functions in CICs. Hence, the population distribution at 18:00 will be more scattered rather than concentrated, which is indicated by the decrease in PRHA between 16:00 and 18:00. In contrast, a smaller functional mix within USTB demonstrates a slight decrease in PRHA from 16:00 to 18:00. On the other hand, the density of the boundary spaces of PUHSC is reduced, whereas its PRHA increases. The explanation may be related to the low entropy of PUHSC's boundary spaces (which mainly offers medical services). The population in this area will decrease at the day moves toward closing time, around 18:00, for many outpatient medical services, which leads to the concentration effect increasing the PRHA due to stable population of inpatient services. In contrast, owing to a high land use mix within BUAA's boundary space, there is a dramatic decrease in PRHA compared to its stable population density, which suggests the high land use mix there contributes to distribute the population more evenly in the boundary spaces during the service time.

6.3.4 The space use balance on 15 selected campuses: to examine the space use mechanism of modern CICs in present day Beijing

The population density of modern CICs in cluster areas is higher than the surrounding urban environments. In the three cases, the space use balance (higher DPMHA as well as decreasing PRHA with high population densities.) correlates with land use mix. In addition, 12 other campus CICs has been examined in this dissertation. Based on the data analysis of space use vitality, land use mix as well as enclosure-gating systems in the 15 campus CICs, a clear correlation between DPMHA and land use mix is revealed (Table 6.4 and table 6.5), which suggests a higher land use mix contributes to forming a more balanced space use by large number of people inside these modern CICs. However, the CIC enclosure-gating systems do not have a clear correlation with the land use mix and DPMHA. This cannot prove the inexistence of the positive role of the enclosure-gating system to the stable inside space use balance without, because the interruption from outside public has been segregated by the enclosures and gates.

Figure 6.33 and Figure 6.34 reflect a balanced distribution of the population among working and living spaces on campus CICs. On each campus, the distributions of DPMHA in different land uses of inner spaces in each campus are similar. However, these campuses also have distinctive space uses due to their respective traditions and characteristics in higher education. All the work and residence spaces have been stimulated and the DPMHA similar for most campuses. Though the work and residence spaces have a great proportion in DPMHA, the landscape and service spaces inside campuses also constitute a high proportion of DPMHA on each campus. In addition, the social production spaces for teaching and researching only account about 1/3 to 1/4 of the DPMHA and the DPMHA is quite high in consumption spaces for residence, service, entertainment, sport and culture, etc. On the main centre campus of PKU, the research and teaching spaces account for 41.1 % of DPMHA, which is the highest among the 15 study cases. This reflects that the teachers and students in PKU spend more time for working and studying inside offices, classrooms, laboratories and libraries, though there are large-scale gardens in the campus. On the other hand, a large number of dormitory and service buildings as well as affiliated schools have been constructed outside the campus to decrease the proportion of residence population inside the campus, which also contributes to the increase of proportion for people working and studying inside the campus. On the BIT campus, the DPMHA of institute buildings is less than 10%, which may suggest a more scattered distribution of the population because the existence of a large number of low-rise engineering test buildings reduced the population density. The campus of China University of Geosciences in Beijing (CUGB) has the largest DPMHA (20%) in sport buildings, which may be due to that geology attracts students who prefer the outdoor activities (Gu et al., 2019).

The large proportion of DPMHA in service and residence spaces also revealed the preservation of independent life inside present day campus CICs. In contrast to other universities, the larger DPMHA of culture and landscape spaces of Minzu University of China (MUC) and Renmin University of China (RUC) reflects the teachers and students' strong pursuit of humanistic and leisure atmosphere. Moreover, because campus CICs also include individuals working here but not living here, the comparatively larger population working and living here in day time also demand sufficient service, culture activities, green areas as well as sport spaces during leisure time.

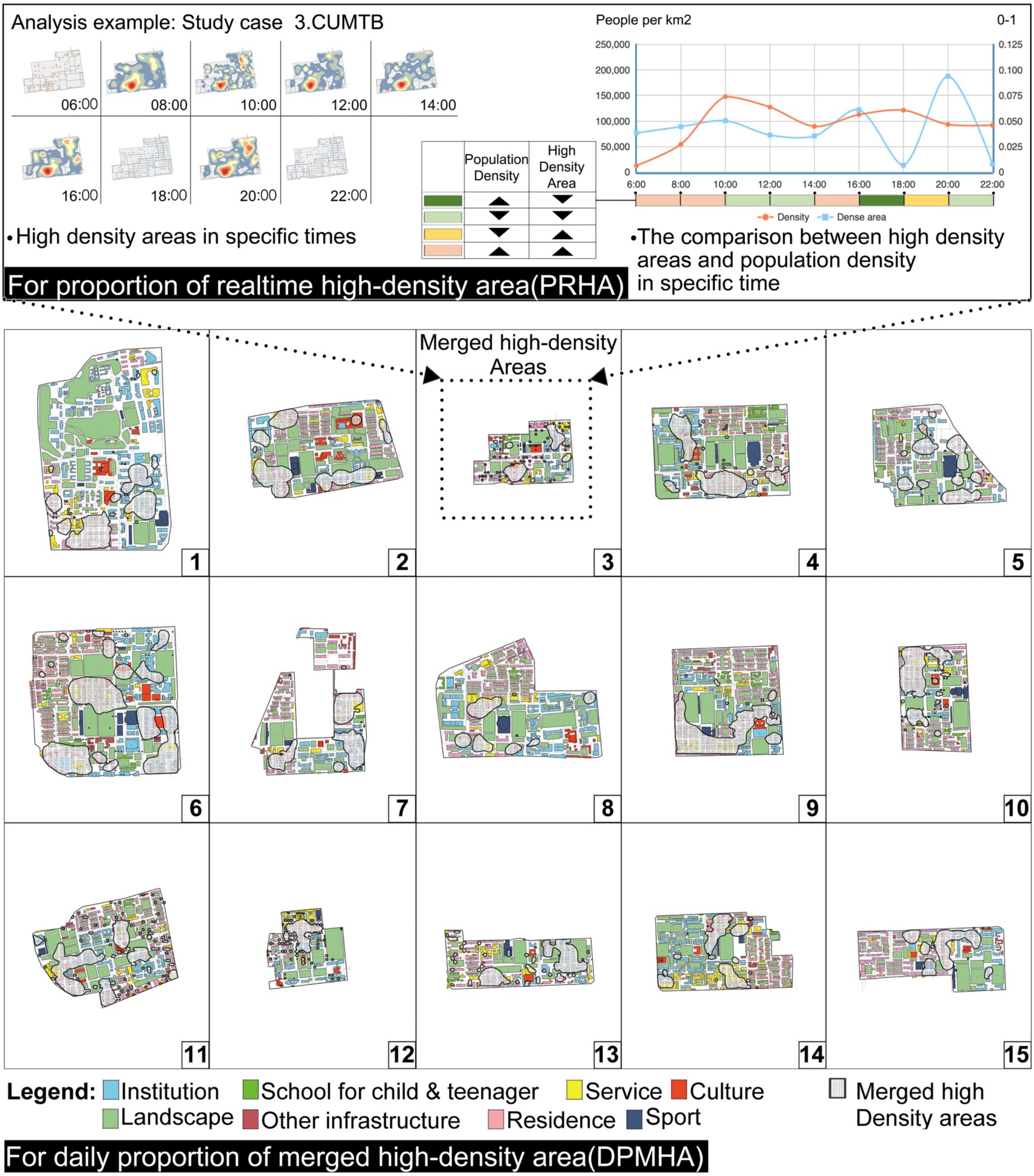


Figure 6.33. 15 campus CICs in the CIC cluster area and the DPMHA of them. CUMPT is the abbreviation of China University of Mining and Technology (Beijing). Resource © (Gu et al., 2019).

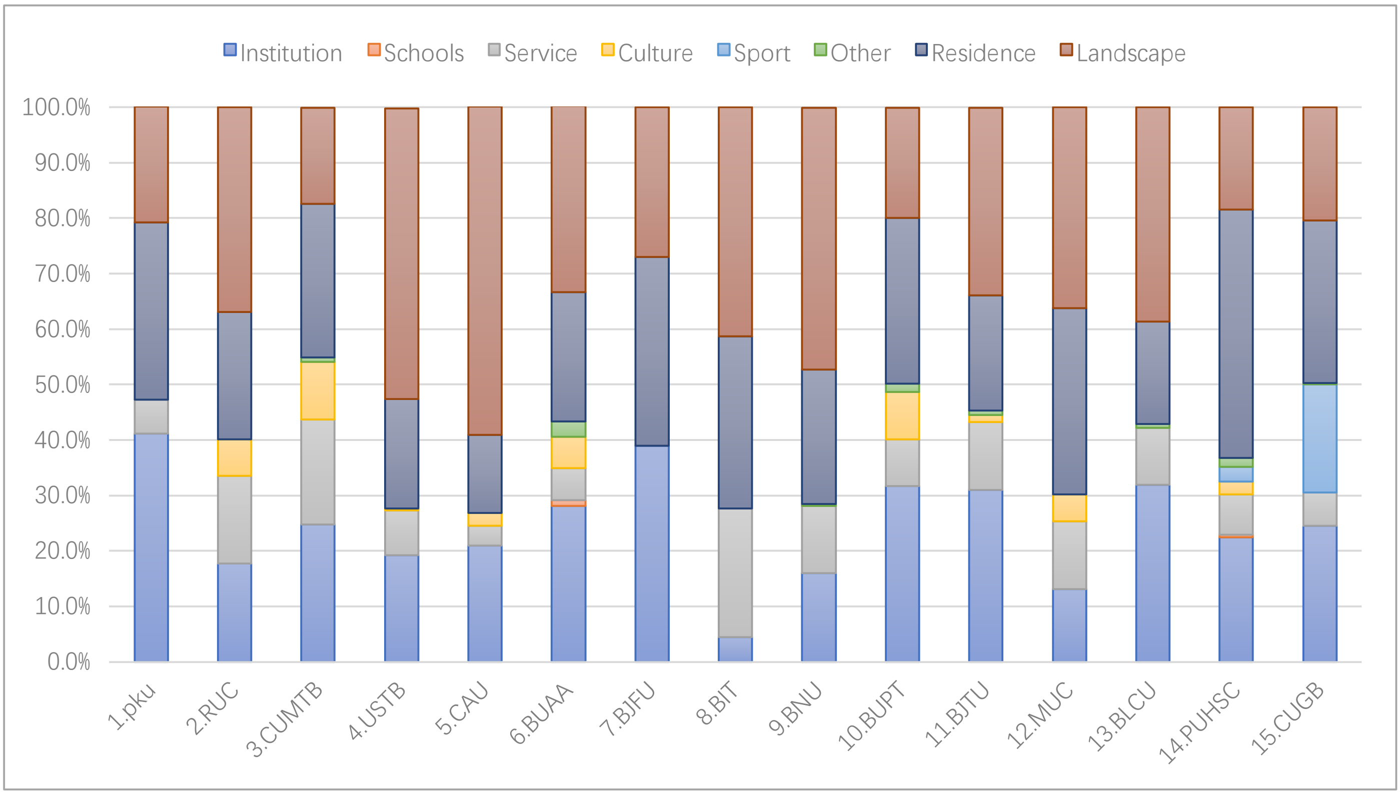


Figure 6.34. Distribution of land uses in the DPMHA among 15 campus CICs. Resource © (Gu et al., 2019).

	DPMVA	ENTROPY	ENCLOSURE & GATING	GENDER (FEM/M)	FUND (HIGH-TEC)	CIC_AREA (SQ KM)	RANKING	INSTI_AREA (SQ KM)	SERV_AREA (SQ KM)	RESI_AREA (SQ KM)
1.PKU	0.125	0.693	0.15	52%	2.846	1.206	1	0.603	0.158	0.214
2.RUC	0.217	0.697	0.06	58%	0.085	0.622	7	0.304	0.076	0.357
3.CUMTB	0.166	0.723	0.04	33%	0.239	0.258	35	0.098	0.042	0.226
4.USTB	0.163	0.650	0.06	44%	0.239	0.633	39	0.225	0.043	0.33
5.CAU	0.189	0.643	0.05	54%	1.684	0.471	26	0.209	0.014	0.355
6.BUAA	0.228	0.806	0.06	26%	2.701	1.065	21	0.49	0.04	0.314
7.BJFU	0.223	0.620	0.04	64%	0.230	0.443	66	0.227	0.035	0.396
8.BIT	0.087	0.551	0.10	35%	2.626	0.723	32	0.49	0.074	0.357
9.BNU	0.240	0.737	0.05	56%	0.681	0.590	11	0.328	0.058	0.317
10.BUPT	0.252	0.750	0.04	36%	0.351	0.370	69	0.157	0.047	0.243
11.BJTU	0.227	0.658	0.12	47%	0.653	0.581	46	0.278	0.083	0.481
12.MUC	0.169	0.621	0.04	67%	0.016	0.253	80	0.174	0.028	0.114
13.BLCU	0.245	0.750	0.06	75%	0.002	0.360	202	0.112	0.044	0.197
14.PUHSC	0.226	0.710	0.11	70%	2.846	0.480	1	0.175	0.036	0.231
15.CUGB	0.181	0.638	0.05	42%	0.320	0.396	44	0.174	0.042	0.293

Table 6.4. The general statistics of 15 campuses. Resource © (Gu et al., 2019).

Model 1	Estimates	Std. Err	Model 2	Estimates	Std. Err	Model 3	Estimates	Std. Err
(Intercept)	0.131**	0.081	(Intercept)	(0.348)	0.114	(Intercept)	(0.349)	0.073
Fund	(0.030)	0.031	Fund	(0.019)	0.020	Entropy	**0.653*** **	0.087
Total_area	0.201	0.132	Total_area	(0.086)	0.096	Total_area	(0.077)**	0.021
fm_ratio	0.025	0.107	fm_ratio	0.092	0.067	fm_ratio	0.123*	0.039
Ranking	0.000	0.000	Ranking	0.000	0.000	Resi_area	0.273**	0.064
Insti_area	(0.184)	0.324	Insti_area	0.194	0.218			
Serv_area	(0.606)	0.627	Serv_area	(0.525)	0.512			
Resi_area	0.121	0.147	Resi_area	0.250*	0.085			
			Entropy	**0.656** **	0.147			
			Enclosure	0.175	0.424			
R square: 0.516			*R square: 0.906*			*R square: 0.875*		
Remarks: Significance code: '***' : 0.001 '**' : 0.01 '*' : 0.05								

Table 6.5. Results of the regression analysis on covariates that influence the DPMHA of campuses. Resource © (Gu et al., 2019).

Model 4	Estimates	Std. Err	t value	Pr(>|t|)
(Intercept)	-0.370	0.085	-4.349	0.02245 *
Entropy	0.717	0.100	7.153	**0.00563 ** **
Enclosure	-0.652	0.700	-0.931	0.42054
Gender_ratio	0.066	0.041	1.588	0.21046
Fund	0.020	0.022	0.929	0.42137
CIC_area	-0.078	0.074	-1.044	0.37319
Ranking	0.000	0.000	0.309	0.77732
Insti_area	-0.179	0.225	-0.796	0.48417
Serv_area	0.766	0.799	0.959	0.40831
Resi_area	0.392	0.147	2.673	0.07553
Multiple R-square: 0.9739, Adjusted R-square: 0.8956, F-statistic: 12.43 on 9 and 3 DF, p-value: 0.03099				
Remarks: Significance code: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Table 6.6. Results of the regression analysis on covariates that influence the DPMHA of campuses (Without considering the data of 3. CUMTB and 12. MUC).

In the regression model (see Table 6.5), entropy significantly influences the DPMHA. If we remove the data on entropy and enclosure (scale of CIC / number of gates) from model 2, the R square decreases from 0.906 to 0.516, which also suggests a lower explanatory power about the relationship of DPMHA and other variables. In the ranking of the variables based on their importance with regard to influencing DPMHA in the model, the data on entropy for land use mix, female-male ratio as well as the square kilometres of residence areas and total area of each CIC account for the most important ones. Again, the enclosure-gating systems for CIC members do not have a close association with DPMHA in the regression model, which reflects the current low explanation power of regression analysis in revealing the role of enclosure and gating systems, based on the calculation of CIC scale and number of gates, in maintaining the independent CIC life styles.

In table 6.6, when the data of CUMTB and MUC was excluded in the regression analysis, the R-square grows to 0.973, which suggests the mixed land uses enclosed within relatively small areas of these two campuses cannot balance the inside space uses by high population densities as the other larger campus did. Therefore, the development of surrounding public urban environments plays a significant role in supporting the lives of CIC members of CUMTB and MUC.

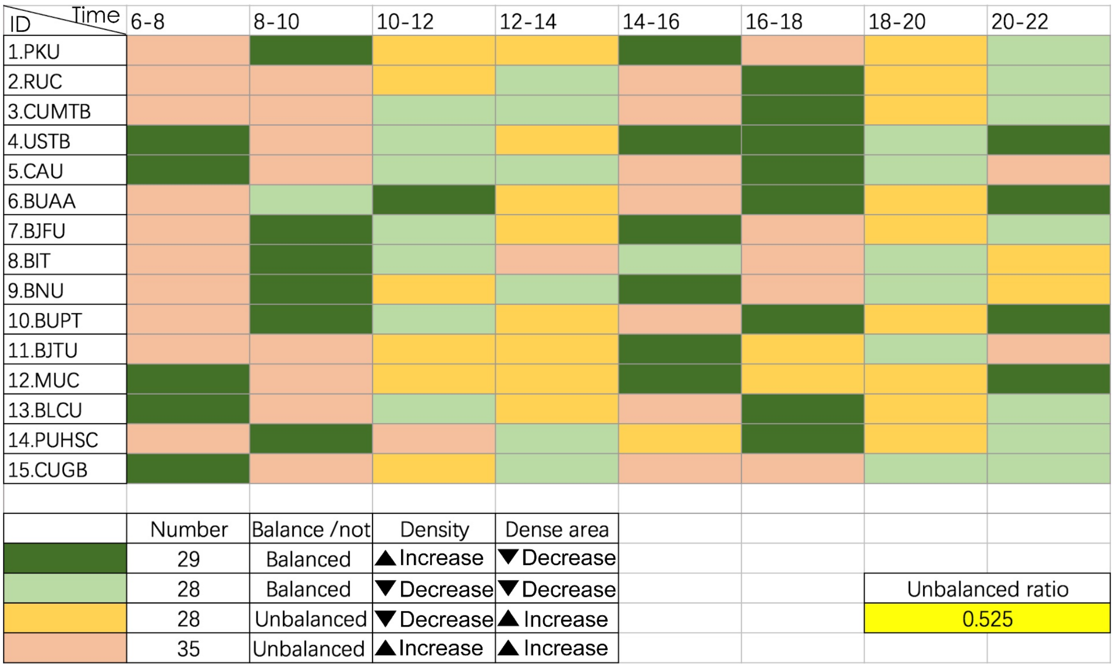


Figure 6.35. Space use balance based on the distribution of balanced and imbalanced states among eight periods within a day within 15 campus CICs. Resource © (Gu et al., 2019).

The dynamic transformation of space use (im)balance on campuses with high population densities can be observed by combining the analysis of changes of population density and square kilometers of the area of high population densities (abbreviated as "dense area", see the left-top part in Figure 6.33). The "dense area" here can also be replaced by proportion of real-time high-density area (PRHA) due to the total area of each CIC is stable. Even though the population densities of CICs decrease during some time periods, they are still much higher than those in the surrounding urban environments (see Figure 6.28), which suggests the population densities in campus CICs keep a much high level during a whole day. Hence, the drop of proportion of real-time high-density area will be defined as the process of losing the space use balance. In Figure 6.35, the space uses inside campuses become more imbalanced during half of the time from 6: 00 to 22:00. However, the rise of population densities and decrease of dense areas between 4pm and 6pm for more than half of the campuses shows the large CIC consumer spaces increase the space use balance on campuses by distributing the increasing population more evenly into the mixed-use spaces. On the other hand, between 10am and 12pm, the drop in both population densities and dense areas (marked with yellow colour in Figure 6.35) indicates consumer spaces in surrounding urban environments absorb and serve the people who live and work inside CICs, which contributes to balancing the space use inside CICs. In addition, between 8pm and 10pm, the land uses in only two campuses become unbalanced, which confirms that the mixed land uses can balance the distribution of the local residents.

6.3.5 The present day balance of CIC space use benefiting from the combination of TND and TOD development

The expansion of higher education leads to the fast growth of student population, which also produces higher population densities inside CICs than in the surrounding urban environments. During leisure time between 10am and 12pm as well as between 4pm and 6pm, more than half of the campus CICs have a land use balance (see Figure 6.35). The high degree of land use mix inside the campuses contributes to the balanced distribution of high population densities. In addition, the enclosure-gating systems maintain the space use balance by limiting public visits. The impermeable enclosure-gating systems also protects the CIC members from risks including viral infection, threat of robbery as well as noise and air pollution produced by public transportation, etc. However, the gating systems are much more permeable for the CIC members, which suggests a high level of freedom for these individuals to compare and choose services inside and outside CICs. Before 1978, urban government could not meet the demands of CIC members, which forced the production of a self-contained life style within CICs. After 1978, accompanied the boom in the population of campus CICs, the rapid development of the surrounding businesses and services started to absorb the CIC populations, which continues to contribute to the space use balance in campus CICs of the present day.

In figure 6.36, the locations of campus CICs, subway stations and science-tech parks are close to each other. Between PKU and RMU is Zhongguancun Science and Technology Park, one of the largest innovation centres in the fifth ring. Close to CUGB and BLCU, there is another Technology Centre called Tsinghua Science Park (TusPark) where 6 commercial compounds located near the south gate of Tsinghua University. A large number of emerging innovative companies were lured by the universities to locate their offices in the high-rise buildings close by, creating opportunities for college students to work for these companies to advance their careers when they are in school. Within or surrounding these science-tech parks, a variety of public services including shopping malls, super markets, restaurants, cafes and bars are integrated. These rich public offerings are also near the subway stations, which provide alternatives for individuals both in CICs and the outside public. The TusPark is one part of the fragmented boundary spaces of the CIC for THU, which produced the buffer area which is also a place where CIC inhabitants encounter the general public.

In conclusion, the close proximity between campus CICs, subway stations as well as public business and service buildings aid the integration of traditional neighbourhood development (TND) and transit oriented development (TOD) in present day CIC cluster area of Beijing. Within their enclosures, each campus CIC includes the key attributes of TND development including public spaces, well-connected road systems as well as varied land uses combining residences and services (Katz et al., 1994, Kulash et al., 1990). Moreover, the Chinese campus CICs have greater complexity and mixed functions including collective working, living and services than TND projects in American where the working and living spaces may be far away to each other. Close to the gates of CICs, there are subway/bus stations where diversified service functions and offices surround as TOD nodes. Beyond the earlier developed TND projects with complex land uses, the later TOD concept for developing suburban areas also embedded campuses deeply into the modern urban areas as CICs.

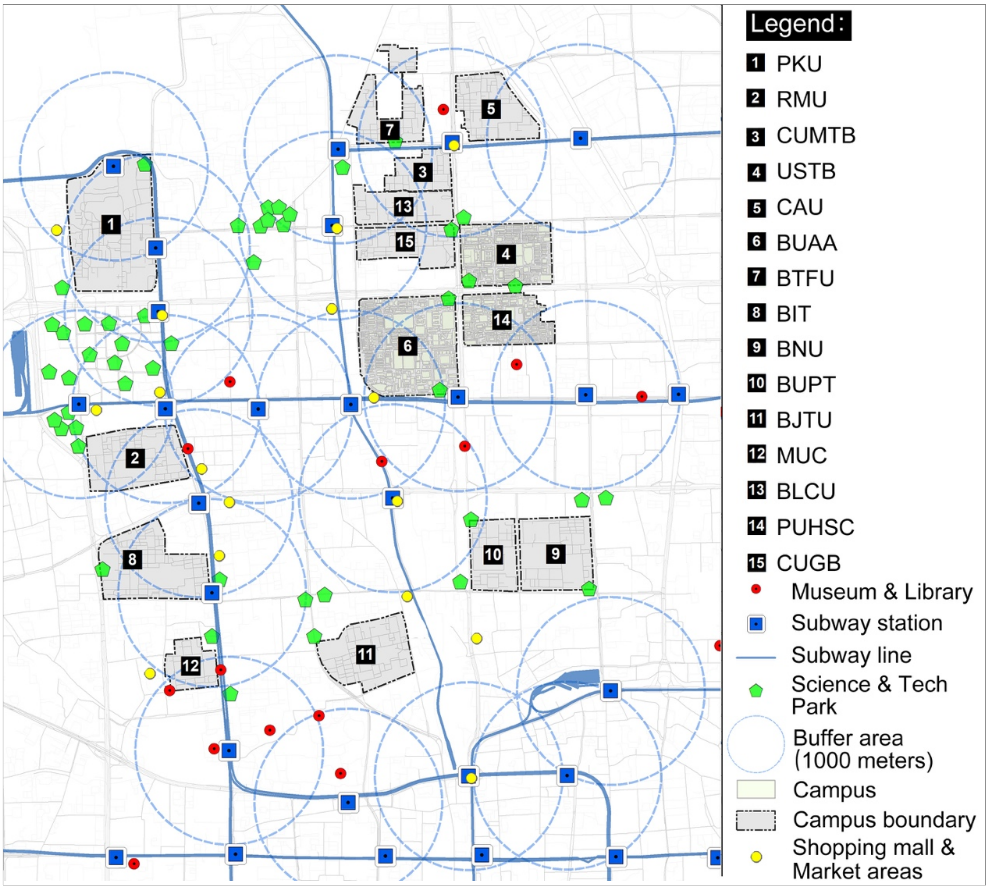


Figure 6.36, Spatial proximity of campuses and other related public infrastructures. Figure adapted from (Gu et al., 2019) by the author.

6.4 The multi-levels' transformation of modern CICs starting from the enterprise reform in 1990s

6.4.1 The fall of modern CICs: the urban industrial transformation in Beijing

After 1949, China tried to increase industrial production to meet people's demands for the basic necessities of life as soon as possible. A central planned economy based on that of the Soviet Union was established by the central government to transform China from an agricultural country into an industrial country. In this context, the construction of CICs by state-owned enterprises played a key role in post-war production as well as in the organization of the urban life. The high accessibility between the working areas and living areas in each work unit led to close neighbourhood relationships among the workers. Wu (2005) wrote that sometimes several enterprises even shared one residence area. Though the Soviet experts assisted in the construction of residence areas for workers (Zhang et al., 2009c), the Chinese people organized their collective life within the gates and enclosures of work units, which made modern Chinese CICs different from the collective communities in other communist states, which developed the concept of "social condenser" (Hudson, 1986, Murawski, 2017a, Castillo, 1997).

Figure 6.37. The left map: the location of CBD area in Beijing. The black and white map on the right: the original land use map of CBD area of Beijing in 2001. Resource © Zhang (2004) / Beijing Municipal Institute of City Planning & Design (BICP). The grey blocks in the map on the right represented the locations and areas of enterprises before they were removed during the market reform. The floor area ratio (FAR) of industrial land in China is generally from 0.7 to 1.2, which is one of reason pushing the urban land use transformation into the tertiary sector with a potentially higher FAR to create the higher added value. Figure drawn by the author.

New urban planning projects were classified by the land use according to scale zoning with specific main functions: educational and scientific, industrial as well as governmental after 1949. A huge proportion of urban industrial production was situated to the east and south areas outside the old town in Beijing (see Figure 6.1). The leadership of Chaoyang district constructed a large number of enterprises in the centrally planned economy period and the area of present-day Central Business District (CBD) in Chaoyang was originally a CIC cluster area of about 28 work units of different state-owned enterprises (Figure 6.37). This area was also home to two campuses for higher education and several government agencies. In the central planned economy period, the CICs of industrial workers accounted more than half area of the zoomed-in territory in figure 6.37. State enterprises encountered developmental bottle-necks in the coming reform for establishing a market-based economy which brought the fresh air to the private domain after 1978. After 1992 the work units which originally constituted the main force of second industrial production encountered marketization, which brought more competition to state enterprises, and the commercialization of banks, which hardened the budget constraints of state enterprises (Guo and Yao, 2004).

Though the development of an urban secondary industry brought income for municipal finances, it also produced air and water pollution threatening citizens' health. In the market-based economy, the negative influence of resource intensive industrial pollution on environmental quality has generated a high awareness of damage caused by pollution and demands for environmental protection in China (He et al., 2014, He et al., 2012, Jahiel, 1998). However, the existence of a large number of low value added local-collective enterprises could not stand in the way of transforming the urban industrial structure from low-end to high-end manufacturing. The government planned the enterprise reform to enhance competitiveness and to transform the production methods of enterprises since "industry stands at the core of China's reform problem" (Jefferson and Rawski, 1994). The upcoming economic reform successfully upgraded urban industries (Gereffi, 2008) and east coast cities, including Beijing, Shanghai and Guangzhou, were given priority to grasp this opportunity; however, this resulted in continuous attacks on those state-owned enterprises in the globalization process after 1992 due to harsh competition, which also presaged the upcoming challenges to the modern CIC lifestyle of the enterprise work units. The outdated factories were phased out and the lands were transferred to emerging industries. In present day CBD area of Beijing (see Figure 6.38), high rise commercial buildings have replaced the state enterprise CICs.

Beginning in the 1990s, thousands of work units fell to the institutional reforms of industrial production. Large numbers of workers used to stable work in state enterprises became unemployed, a negative effect produced in the market-based economy in China. In 2001, China became the 143rd member of the World Trade Organization (WTO). In that year, the number of employees in private urban units of enterprises surpassed that of the public-owned ones which were mainly controlled by the state. After that, the proportion of employees in urban units for all walks of life kept growing year after year. Accompanying the increase in employed population, the speed of growth of private units was far higher than the decreasing speed of public-owned units (see Figure 6.39). The economy reform stabilized the society with an increased demand for employment in the private sector, which in turn also stimulated the state's support for emerging industries. Another important social impetus was on-going urbanization as Chinese cities absorbed rural immigrants (Zhang and Song, 2003, Wang et al., 2000, Wu, 1994) as well as those from other countries (Pieke, 2012).

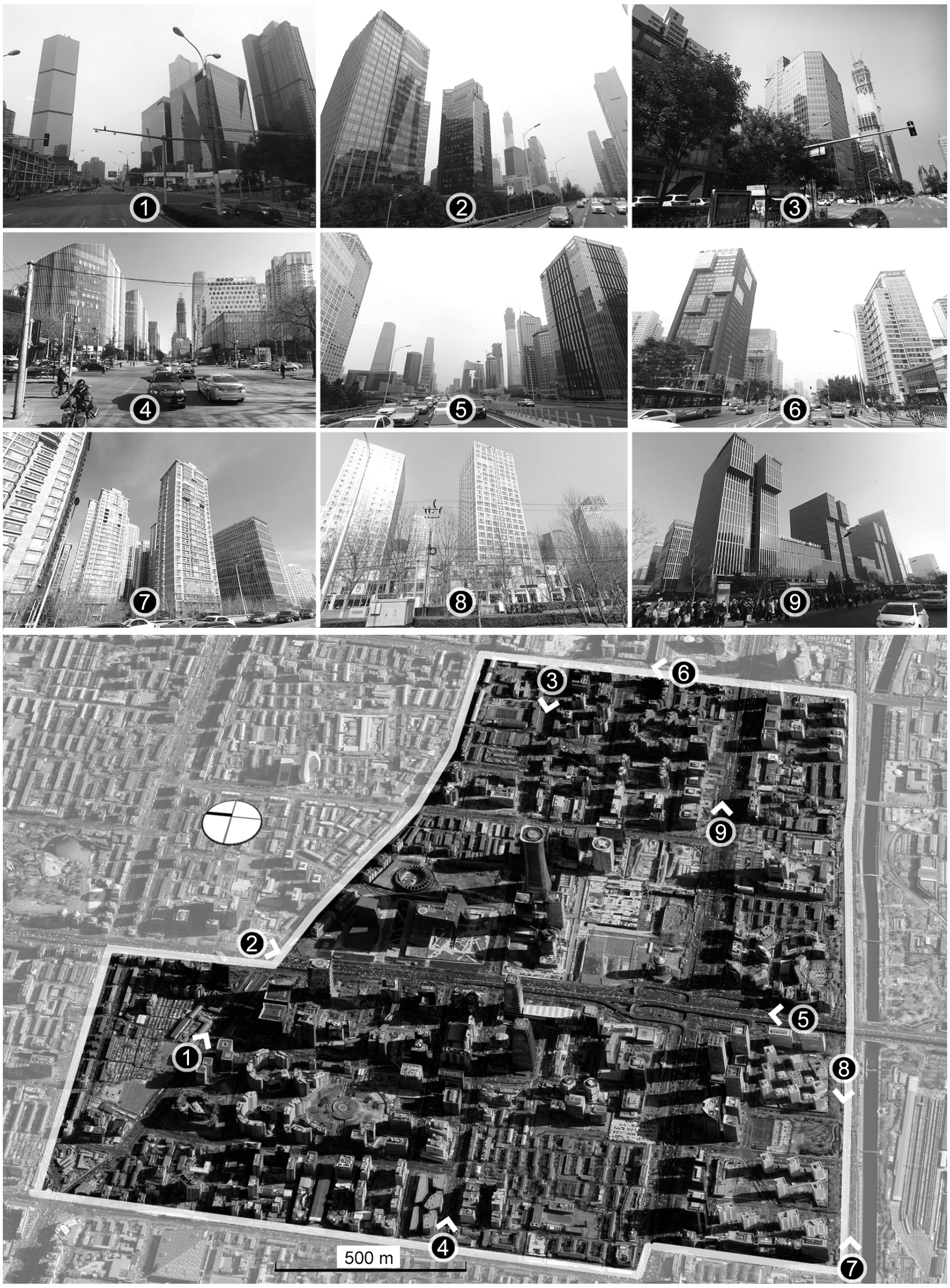


Figure. 6.38. The CBD area in present day Beijing. The CBD area has erased almost all memory of those state enterprises and constructed many skyscrapers for new commercial service functions. Figure drawn by the author. Photos: ©Baidu street view map and Google satellite map.

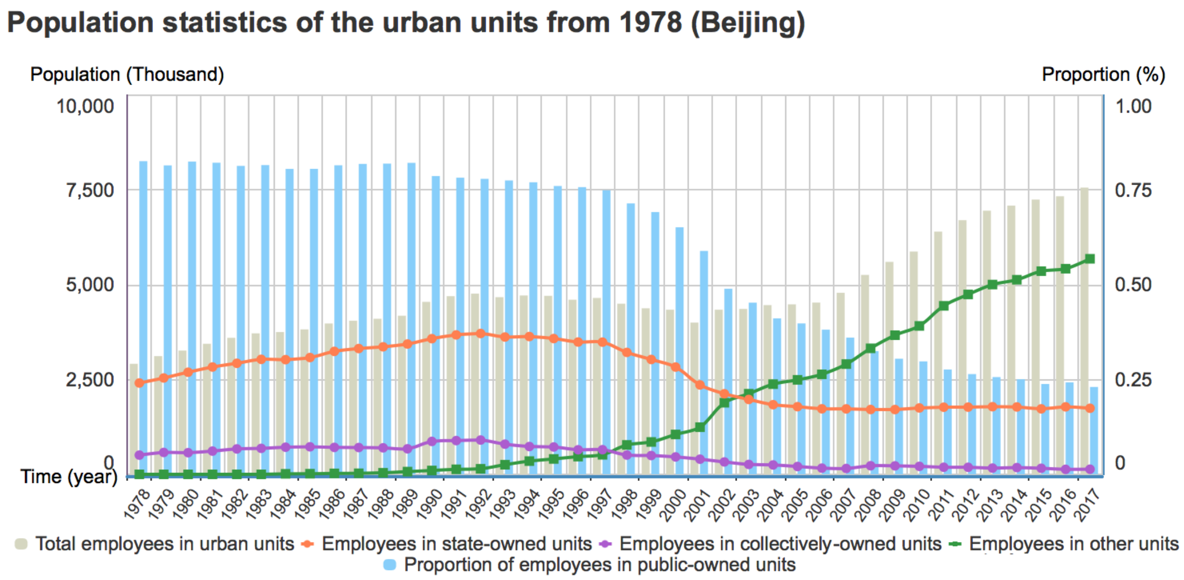


Figure 6.39. Population statistics of employees in urban units from 1978 to 2017 (Beijing). The employees referred to here in publicly-owned units are mainly employees in state-owned and collectively-owned units. Table drawn by the author. Data source ©(Beijing Municipal Bureau of Statistics and Beijing, 2018)

6.4.2 Preserving and reusing modern CIC spaces by involving emerging industries which destroy the CIC lifestyle

Though a large number of CICs, constructed by enterprises which collapsed during the market reform, were transformed into the commercial communities, some modern CIC spaces were preserved in the name of preserving the industrial heritage. In addition, some residence areas of CICs were also preserved due to the high cost of urban reconstruction, which also became a historical issue for many old urban residence areas. However, with the reform of the welfare system, the residence areas within the enterprise CICs lost their strong support from their work units in promoting public service. In a contrast, the industrial heritage buildings with spatial transformations for emerging industries gain more social attention and resources in current development.

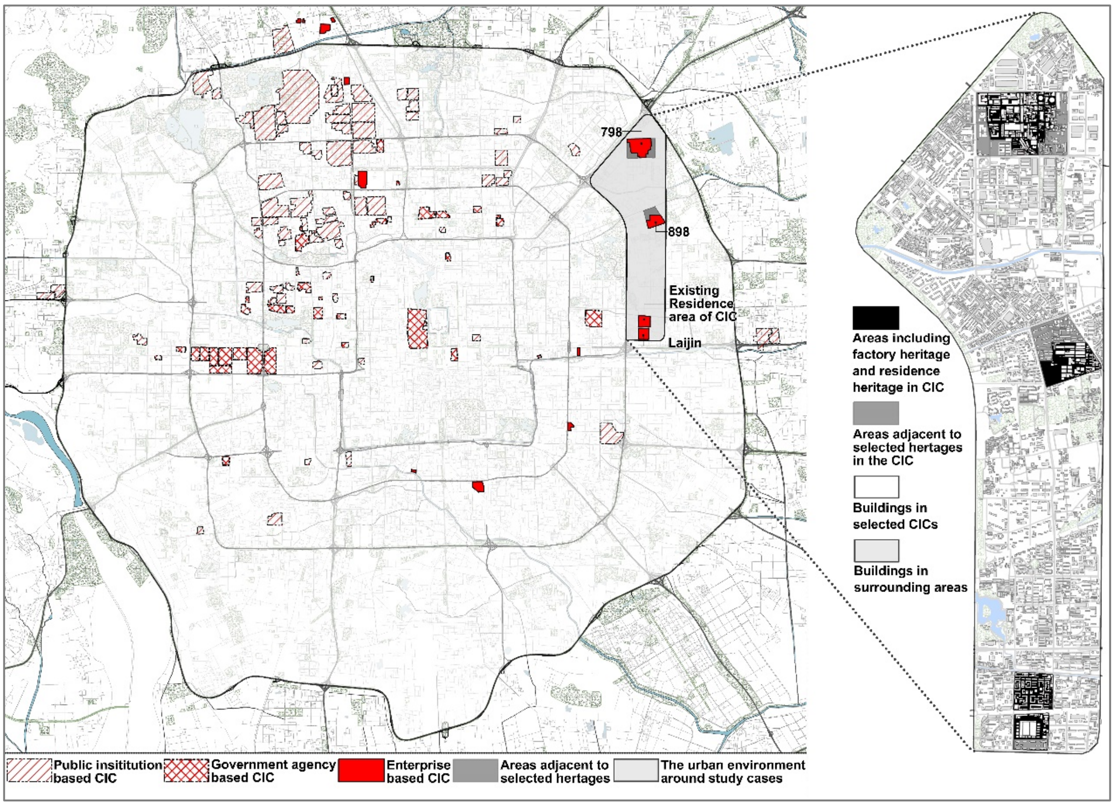


Figure 6.40. The locations of three enterprise CICs in Chaoyang district and their urban environments.

After 1992, emerging industries in the service and tech-innovation sectors were welcomed by city governments in China. Beijing, as a central city for politics, culture, and economy in China, started a new round of reforms in urban planning and management. The existing work unit CICs, controlled by state-owned enterprises, were also given the opportunity to revitalize spaces in their CICs by integrating private companies.

The rise of the market-based economy helped transform the land use attributes of work units from industrial land (low FAR) into commercial land (high FAR). With this change, new high-rise residence buildings and office buildings were built inside and on the CIC boundary spaces with an influx of private capital. In the three case studies examined here, the boundary spaces became fragmented and opened to the outside public. To some extent, the process of revitalizing enterprise CICs was also accompanied by the destruction of their collective lifestyle. Based on the in-depth interviews with the enterprise managers of 798 and Laijin, the multi-levels' transformations of modern CICs have been examined in this dissertation. In the field studies on the three enterprises, **three phenomena of space transformation in CIC inner and boundary spaces** were discovered to explain the functional transformation, space preservation and fragmentation.

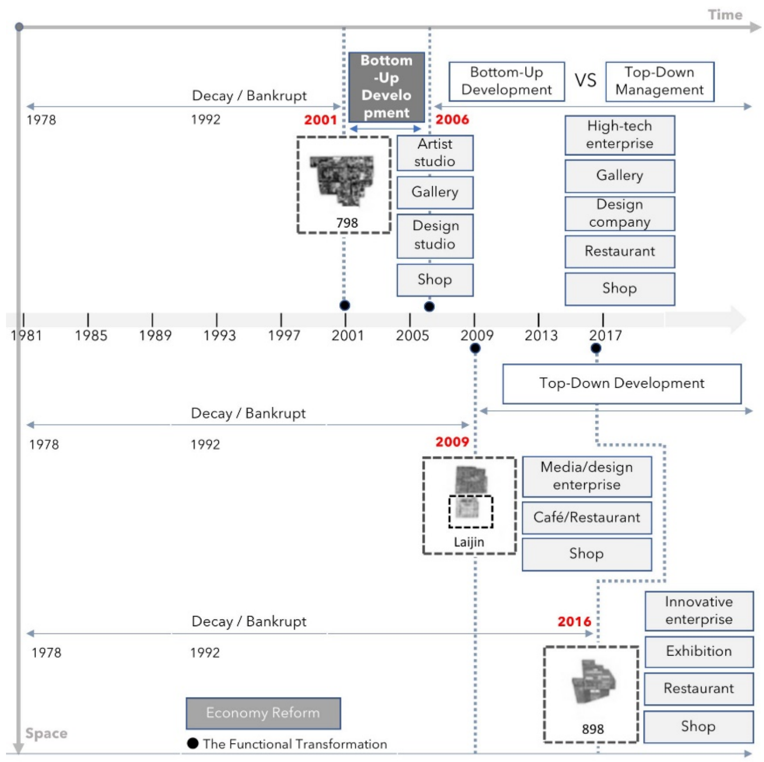


Figure 6.41. The chronology of functional transformations of three cultural preservation projects for industrial heritage in CICs. Figure drawn by the author.

The first phenomenon is transforming and reusing the industrial heritage buildings of a CIC. In this process, there were clear distinctions between the top-down oriented and bottom-up oriented spatial transformations, the chronology of which in transforming different CICs also reflects the increasingly significant role of the work unit in managing the reuse of CIC spaces (see Figure 6.41). The earliest transformed one, 798 Art District, was also the only one among the three cases benefited from a bottom-up oriented approach to reutilize the industrial heritage spaces. In 2001, the North China Radio Equipment Joint Factory *华北无线电器材联合厂（718 厂）*, which was in decline, left more and more abandoned production spaces. These large spaces attracted attention of the artists and professors from the nearby art college who became the first group of renters. The arrival of these artists brought in new income for the enterprise. The enterprise managers there were still the land managers and just pulled out of the original heavy production. They became providers of public services for individuals involved in the emerging industries though not, for the most part, for their work unit colleagues. The success of 798 in its early days was due to recognizing the economic value of the culture industry as well as the relaxing of political control over it (Yin et al., 2015). Besides the artists, more and more people opened galleries, which further increased the steady flow of visitors as well as the number shops and restaurants. The vibrant spaces generating social inclusion and cultural diversity in 798 have been advocated in many articles (Currier, 2008, Liu et al., 2013, Ren and Sun, 2012, Sun, 2010). Nevertheless, the cooperation between the artists and work unit members, leading to a bottom-up transformation was not copied by other projects located south of 798; instead the spatial transformation took a top-down approach. Indeed, even in 798, a top-down management became increasing significant in the transformation after 2005 (see Figure 6.41).

Those involved in the top-down oriented management in 798, put pressure on some artists in the art district. When 798 was integrated into the new urban planning in 2005, the municipal policies primarily protected and transformed the industrial heritage buildings to develop new industries rather than maintaining affordable rents for the artists. The rising rents, due to the large-scale and top-down oriented transformation, forced some artists to leave. In Chaoyang district, new high-rise commercial buildings and the thriving income-generating activities also stimulated life inside 798. After 2006, the integration of high-tech enterprises and other commercial services transformed 798 into a more complex work/leisure place (Figure 6.42), suggesting a new competition and cohesion among the various functions. For the artists and gallery managers, the commercial tendency was not in line with their expectation of enjoying a low rent. The rising rents increased their daily worries. Finally, the top-down oriented transformation dominated the bottom-up approach. Moreover, in the top-down oriented spatial transformation in 798, the stronger emerging industries replaced the artists.

Figure 6.42. The newly built office buildings for Audi and Volkswagen (in a sub-area named 751) inside 798 area. Photo taken by the author in 2018.

The second transformation phenomenon appears in the fragmented CIC boundary spaces. In contrast to the preservation of the industrial heritage buildings inside a CIC, the land use of CIC boundary spaces took two different paths: some of the fragmented boundary spaces were commercialized while others were kept in their original state. The artists started to participate in the transformation of 798, in 2001, the same year that China joined the WTO and began a new round of economic reforms. In particular, the economic changes exerted greater influence on the decline of the work units controlled by state enterprises. The CICs for people living and working together were transformed step by step into urban public communities for enterprises, especially for privately-owned companies. The increasing number of commercial companies and high-tech services were thoroughly integrated into the CIC spaces originally regulated by the traditional secondary industrial sector. More and more gated CICs started to open to the public with newly-established functions. Moreover, the land use change in CIC boundary spaces further exacerbated the spatial fragmentation of CICs. For example, high-rise commercial residence and office buildings rose in the northwest boundary space of 798, and the southwest boundary space was physically isolated from the CIC inner space to build large-scale commercial buildings for high-tech companies like Qihoo 360 Technology (see Figure 6.43).

Figure 6.43. The new commercial office buildings built in the southwest boundary spaces of 798. This asset is controlled by its major shareholder, the state-owned enterprise Beijing Sevenstar Science & Technology Co., Ltd. The original enterprise work unit also owns almost 100% of the land assets of 798 heritage project. Photo taken by the author in 2019.

The south part of the CIC plant, in which Laijin also developed, has been transformed into a commercial residence community (see Figure 6.44), named Dongheng Shidai *东恒时代,* a project belonging to a different company named Beijing Fangheng Group Co., Ltd *北京方恒集团*. Fangheng Group Co., Ltd and Beijing Jingmian Textile Group Co., Ltd *北京京棉集团* were both assets of Beijing Fashion Holdings co., Ltd *北京时尚控股有限公司*, which in 2016 merged the original Beijing Textile Industry Bureau *北京市纺织工业局*, Beijing Textile Industry Corporation *北京纺织工业总公司* and Beijing Textile Holdings (Group) Co., Ltd., Ltd *北京纺织控股(集团)有限公司*. Though Beijing Fashion is a state enterprise, the south side commercial buildings near Laijin have become assets of private owners, which made this residence area a gated community for the buyers who could afford the prices. In contrast to the commercialization of CIC boundary spaces, the spaces inside the CIC keeps an industrial land use attribute. Moreover, in Laijin Culture Creative Industrial Park, Beijing Jingmian Textile Group Co., Ltd (the original work unit) continues to own the land and to be in charge of the heritage preservation and transformation. Without the heavy production, the maximization of the fixed assets became the core objective for the managers. The separation of the CIC inner space from its boundary space derived from the involvement of new private asset owners and public users as well as the division of the managers in their social relationship. The market reform contributed to diversifying the space uses of the declining enterprise CICs. The managers of the isolated/commercial boundary spaces and the inner heritage spaces were assigned by the same majority owner to different companies**.** Moreover, they started to serve different consumers by dividing the original unified CIC area into smaller pieces. During this process, some of the land owners halted production in the second industry and became public service providers, selling commercial housing assets and renting offices.

In 798 area, a similar phenomenon also took place in the northwest of its original CIC boundary spaces. The transformation projects inside the CIC and on the boundary spaces were also conducted by different managers and developers. In an interview, the manager Cai of 798 Art District said that the managers in charge of commercialization project of the northwest land regretted selling the land to the developers when they saw the thriving development inside 798. The new owner, HNA Group, Co., Ltd. *海航集团*, transformed this northwest boundary space into a commercial community with an 83 meter-tall office building and two 21-floor residence buildings. During this process, the original boundary territory of the CIC had been detached from its original owner, the state enterprise which still owned the of 798 Art District (see Figure 6.44).

The third phenomenon is the multi-levels' transformations of the land use in three enterprise CICs, where the appearance of differentiated land use attributes suggests the integration of the preservation of industrial heritage buildings and the destruction of CIC spaces. In contrast to the preservation of old industrial buildings inside three factories, some of the CIC boundary spaces (the blue areas in Figure 6.44) were in a dilapidated state and also without land transfers in the early phase of commercialization. Due to the low value of investment in preservation or commercialization in early days, many of these boundary spaces continued in a state of decay while the nearby industrial heritages inside the CIC were thriving. Development came later to the west of 798, the east of Laijin and the southwest of 898 than their nearby CIC spaces. Though the east of Laijin has now developed into a mature community, new construction projects can still be found there. The limits of capital investment and distinctions of land-use value led to the early selected preservation and commercialization of the industrial buildings in a CIC; on the other hand, a later transformation plan for these dilapidated boundary spaces sought to alleviate the resource scarcity of urban land in Chaoyang district. In the end, most of the original CIC boundary spaces were transformed by the integration of commercial service providers into locations open to the public.

The transformation of three CICs was influenced deeply by the economic reform of different urban industries. However, the transformation of sub-areas in each CIC was limited directly by the resources that could be mobilized by the work units based on their similar collective and independent management experiences, which influenced the decision making of each work unit in managing their respective CIC space transformation. Therefore, in contrast to the different transformation times of three CICs (see Figure 6.41), each CIC underwent a similar process to transform their respective sub-areas with different time, intensity and land use attributes (see Figure 6.44). Though, some early transformation projects of heritage buildings were limited due to its zoning for industrial land use, the other industrial heritage areas in CIC boundary spaces developed later due to the lack of investment always had flexible choices in changing land use attributes. Finally, the commercialized areas developed earlier than heritage preservation projects as well as some later transformed boundary spaces both removed the industrial heritage buildings on CIC borders through changing land use attribute. To some extent, the commercialized boundary spaces also function as thick "walls" to buffer the interaction between the inside heritage areas and the outside public. The gates managed by guards and impermeable enclosures of enterprise CICs are still employed by the industrial heritage areas of 798, Laijin and 898.

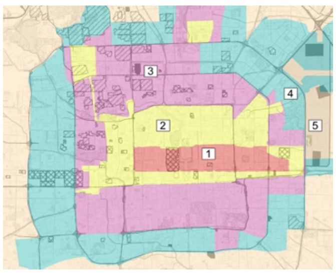
Land use grade	Land locations	Yearly tax (RMB/m2)
①First grade		30
②Second grade		24
③Third grade		18
④Fourth grade		12
⑤Fifth grade		3

Table 6.7. Land use grade classification in Order No. 188 of the Beijing Municipal People's Government. Table drawn by the author.

The motivation for promoting the industrial preservation projects of factories was closely related to the incentive polices for the emerging industries as well as to the different tax polices based on land use classification[32]. With regard to land-use, the three CICs in this

[32] Order No. 188 (Beijing Municipal People's Government_2007) promulgated the "Decision of the Beijing Municipal People's Government on Amending 'the Measures for the Implementation of the Provisional Regulations on the Implementation of the Urban Land Use Tax of the People's Republic of China' in Beijing" *北京市人民政府令第 188 号 公布《北京市人民政府关于修改〈北京市实施中华人民共和国城镇土地使用税暂行条例办法〉的决定》*(Link: http://www.mofcom.gov.cn/aarticle/b/g/200707/20070704895092.html) Later, the *Notice of Beijing local taxation bureau on adjusting the classification range of urban land tax grade in Beijing, 2015 No.10 (北京市地方税务局关于调整北京市城镇土地纳税等级分级范围的公告) was*

study are all located in the fourth and fifth grade land area with low taxes (see Table 6.7). Zhu, a manager in Laijin, also reported that the industrial heritage area enjoyed the lower tax established for industrial land use, which in turn suggests the existence of policies contributing to industrial heritage protection.

The similar transformation sequence of spaces with various land-use attributes in each CIC also reflects the same multi-levels' space transformation regulated by each work unit. **First**, each CIC takes the opportunity to transform itself based on the development of surrounding urban environments. **Second**, the development sequence of different zones in each CIC reflects a self-supporting measure for the transformation of each CIC. **Third**, the choice of bottom-up and top-down oriented transformation influenced the different characteristics of the land use mix.

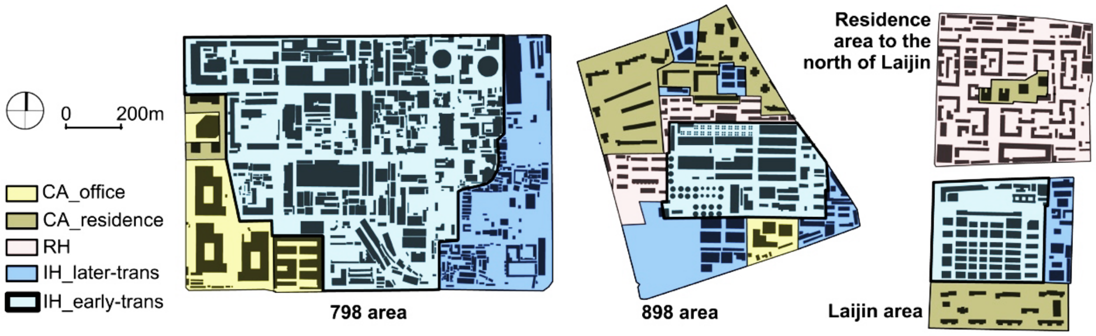


Figure 6.44. The different space transformations in three CIC areas. **CA**: Commercialized area (With land-use change); **RH**: Residence heritage area (The area preserving original work unit residence buildings and related public service buildings); **IH_early-trans**: Industrial heritage areas preserved in the industrial transformation; **IH_later-trans**: The industrial area not preserved in the early industrial transformation and later developed. Figure drawn by the author.

In figure 6.44, the areas of each CIC were divided into three parts: **First**, the area experienced a land transfer to commercial projects; **Second**, the area experienced functional transformation of industrial heritage buildings but limited by the industrial land use regulation to preserve the main structures of old buildings; **Third**, the area remained in a worsened condition at the same speed in the early period but later underwent a new development. Here "the change of land use attribute" refers to land use attribute change from secondary industrial production to commerce regulated. Before 2018, the land use of enterprises was mainly limited due to the fact that it was zoned for industrial use, which made it impossible to build high-rise commercial office buildings in those industrial heritage areas. In addition, it also limited the revenue for work units from the rents of preserved and transformed industrial heritage buildings due to the limit of land use attribute and low FAR of industrial buildings.

released (http://www.beijing.gov.cn/zhengce/zhengcefagui/201905/t20190522_58891.html). In the new classification, these industrial heritage projects still benefited from the lower tax rate for land use.

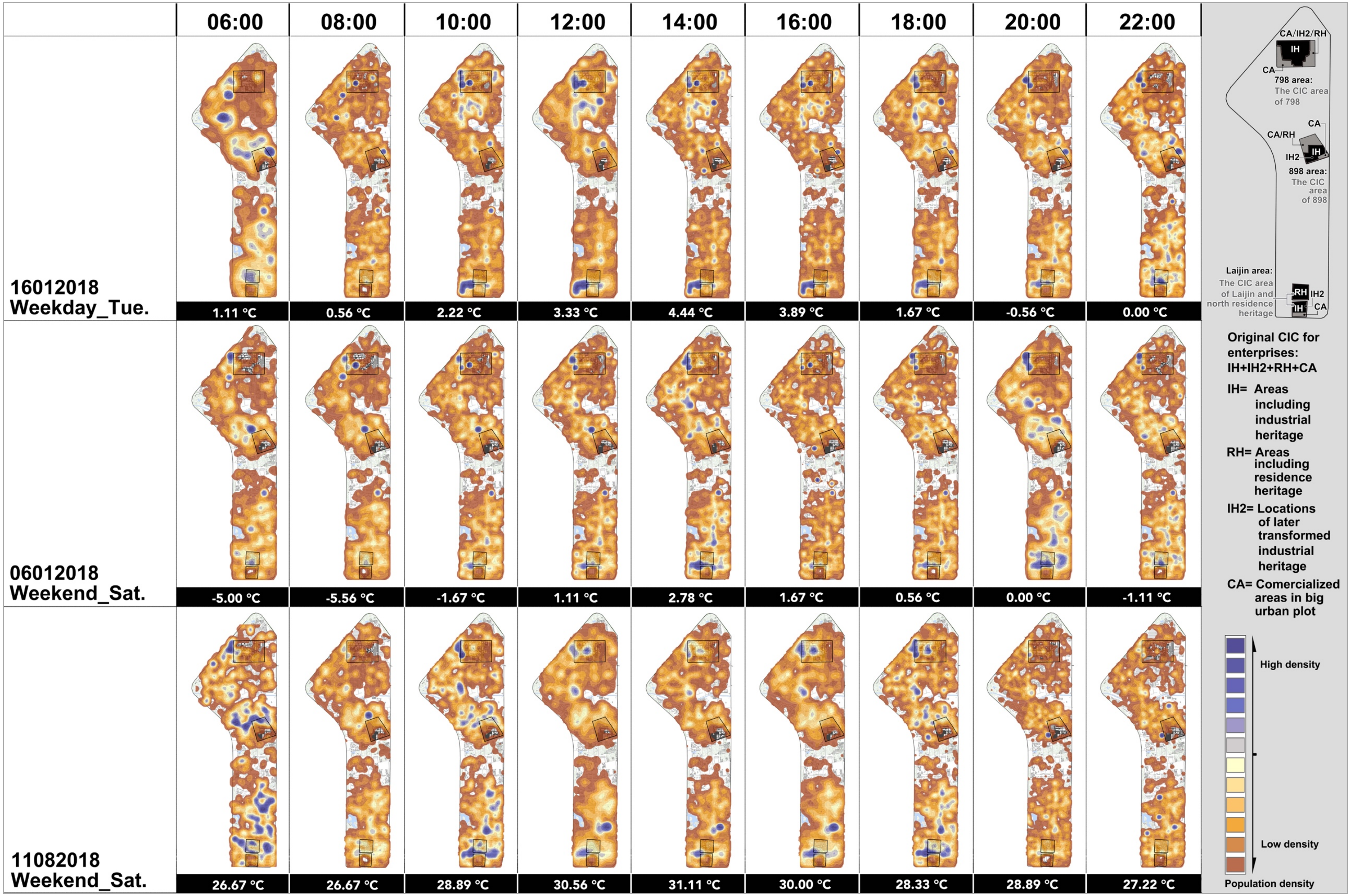


Figure 6.45. The heat map analysis of three selected enterprise CICs and their urban environments. Figure drawn by the author.

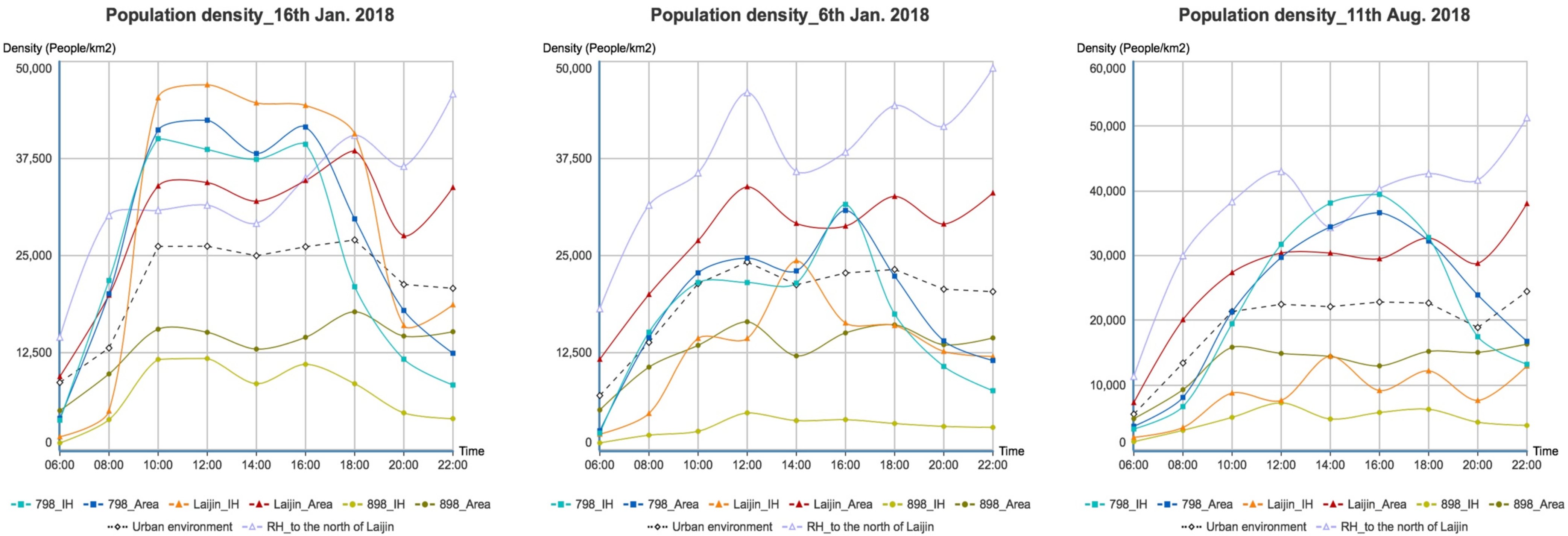


Figure 6.46. The dynamic population densities of three enterprise CICs and the urban environment. The areas signed by "IH" of 798, Laijin and 898 refer to the preservation industrial heritage projects (**IH in figure AA**). Here the "Laijin_area" includes the whole CIC area of Beijing No.2 Textile Factory which is in accordance with information in figure 6.44. Figure drawn by the author.

In order to further explore the effects of the spatial transformation of CICs on space use issues in the present day, the data analysis of the heat map for the three enterprises reveals the space vitality in real time with specific population densities. The overlapped locations with high population densities and various functions indicate the use of spaces with transformed functions that has been stimulated within original CICs (see Figure 6.45). Moreover, a comparison between the three study cases reveals the different effects of bottom-up and top-down oriented transformation paths on the space use mix and vitality, which is discussed and interpreted in section 6.4.3.

In case studies of selected campuses in Beijing, the close relationship between the land use mix, space-use vitality and balance has been demonstrated. Though the social relationships in the three enterprise CICs experienced great transformations, the observation and analysis of land-use issues reflect the similar correlation between space-use mix, vitality and balance as that in campus CICs. The land-use mix influences the space-use vitality and the variety of space users also contribute to a balanced space use at different times from 6pm to 10pm of a day.

The heat map (Figure 6.45) shows the locations of populations with different densities at different times during the week and at the weekend as well as during winter and summer months. Moreover, the vibrant areas in the urban environments can be compared at specific times and between times to reveal the dynamic population flow between inside and outside. Figure 6.46 shows the change of specific population densities in different areas, which reflects the population densities during different working and leisure times study cases. Based on the heat map analysis, population density analysis and land use analysis, the multi-levels' transformation of CIC spaces of each enterprise is evaluated in next three sections.

6.4.3 The spatial transformation integrating the bottom-up and top-down approach in 798 creative park: from art/design studios and galleries to high-tech enterprises and public services

The factory zones occupied by present day 798 Creative Park is an asset of Beijing Seven Star Group. The predecessor of Beijing Seven Star Group (Beijing Sevenstar Science & Technology Co., Ltd. *北京七星集团有限公司*) was the 718 United Factories (North China United Radio Appliance Factories *华北联合无线电工厂*), built between 1952 and 1954. The designers and funding for construction of these factories were all from East Germany. The architects, from Dessau, designed the buildings in Bauhaus style (Figure 6.47). CIC 718 contained six branch factories and a research institute; one of these six factories was 798. In resent day, due to the successful transformation of 798, scholars of urban study just use 798 to represent the whole area (Yin et al., 2015). The Beijing Seven Star Group was the product of an enterprise restructuring in 1999. Sevenstar group occupied the land that had been 798 Art District and went on to manage the high-tech production of electronic equipment as before. However, nowadays 798, which was separated with other production departments, has become an independent service provider for private creative/innovative companies as well as for the public.

Figure 6.47. The old panorama photo of 718 United Factories. Photo © (Yin et al., 2015).

As shown in figure 6.45 and figure 6.46, 798 area had the highest population density among all three enterprises. Most of areas with vitality were located in the west boundary space and the central area in 798. The decay of the industrial heritage areas in east 798 area did not have the high-density populations which bring a location to life. The lack of service functions and poor transportation in the west boundary spaces of 798 also did not help developments in contrast to its border in the east. In figure 6.46, the population densities during the day on working days in the industrial heritage area of 798 (798_IH in Figure 6.44) were a little lower than that of the whole 798 area (798_area in Figure 6.44), and much higher than the whole selected urban environment in Chaoyang district. In contrast, the industrial heritage area inside 798 had higher population densities than that of the whole 798 area between 12 pm and 6 pm on summer weekends. This suggests a variety of people contributed to the local space use vitality, which also shows that the preservation of the industrial heritages and their functional transformation had successfully attracted much more public attention than the other two projects.

On summer weekends, the population density of the industrial heritage area in 798 around 6:00 o'clock in the evening was still higher than that of the surrounding urban environments (see Figure 6.45). This also indicates that the leisure functions integrated in the heritage transformation were successful. Tourists enjoying the leisure time here enlivened spaces in 798, which is likely a key factor in the increase in population density. In contrast to the summer weekends, the cold winter weekends in 798 heritage area (the middle graph in Figure 6.46) did not match the vitality of the summer weekends (the right graph in Figure 6.46). The open space among the heritage buildings in 798 had an advantage in summer over winter in attracting tourists, which also implies the outdoor spaces of 798 in summer become the preferred places during leisure time with comfortable temperatures. Overall, the land use mix and diverse population together constitute the local space use mechanism in the heritage preservation and transformation project of 798.

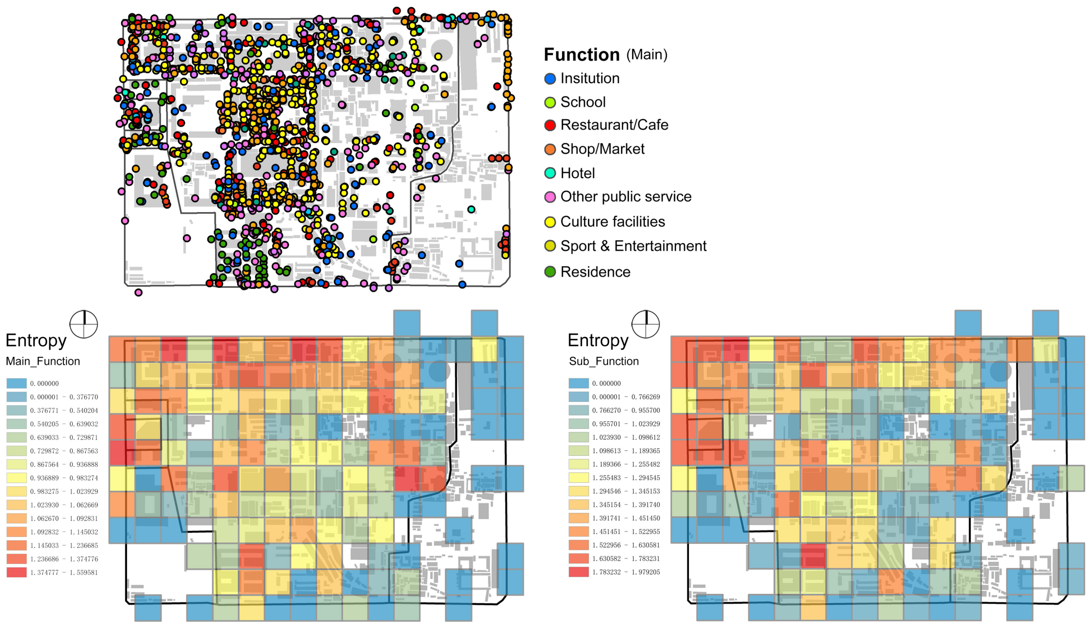


Figure 6.48. Land use mix (entropy) of 798 area in 2016. The land use mix is higher when the entropy is higher. In 2016, the southwest boundary space had not been transformed by the newly built huge commercial buildings (see Figure 6.43). The land uses of other parts of 798 area remained relatively stable before 2019. The entropy of main functions is similar to that of sub functions. Grid size: 80m x 80m. Figure drawn by the author.

In figure 6.48, the land use mix in 798 heritage area has a highly varied and complex nature. Some low-rise buildings even integrated more than three functions, such as an art gallery, design studio, restaurant and grocery. Combined with the analysis of figure 6.41, the formation of the land use mix in 798 can be uncovered. The bottom-up oriented transformation played a crucial role in the allocation of these complex space functions. From 2001, the large building spaces with a variety of shapes attracted artists who wanted to create large-scale sculptures/paintings as well as to live and create communication activities like exhibitions and colloquia. Cai, manager of 798, said that even those strange shaped spaces located in corners that are not easily accessible were popular among the artists. The arrival of the artists also brought new income for the work unit from the rents paid for the spaces. The artists transformed the spaces as an expression of their personality (see Figure 6.49). The open spaces in 798 underwent rapid spontaneous changes led by the new "tenants". The support from the work unit managers helped in this bottom-up transformation. When the galleries, studios and related service entities settled in 798 one by one, the competition for visitors' attention became a challenge to thrive in 798. Every studio or gallery tried to construct an eye-catching entrance and facade. Art installations were also arranged in the open spaces outside their buildings. After only three to four years, 798 had become a popular creative art park. The bottom-up transformation contributed to mixing functions, space users and visitors all together in the preservation project of heritage buildings, which led to the social-spatial mixed space use mechanism in the formation of 798 Creative Park between 2001 and 2005.

Wang Yanling, the manager of Beijing Seven Star Group, stressed the value of preserving those industrial heritage Bauhaus style buildings. With intense contact with artists and education in Europe, this manager enthusiastically promoted the advantages of preserving the heritage and promoting art activities. The issues of rising rents and the gradual loss of some low-income artists in 798 on several occasions have been a hot topic. In contrast, both Cai of 798 and Wang, manager of Sevenstar group, stressed that the number of art institutions had grown from 172 in year 2014 to 285 in year 2018, which suggested that from the angle of work unit managers they successfully promoted the attractiveness of 798 to emerging industries. Moreover, Cai said that rents were not all the same, which should balance above issues. To some extent, the process of reducing the conflicts between the heritage space reuse and artists in 798 also reflected how the top-down dominated power was trying to promote the space use from a marketing perspective. The increase in the number of art institutions, mentioned by the 798 managers, might also suggests the changes of the economic strength of those new tenants. In this process, how long the bottom-up activities oriented by artists and galleries could participate in the space transformation/use also depended on how many opportunities were created by the top-down management controlled by the work unit. To some extent, with the involvement of art and creative institutions, the interaction between bottom-up and top-down oriented transformations is still going on, which is a significant feature in the space use transformation of 798 Art District.

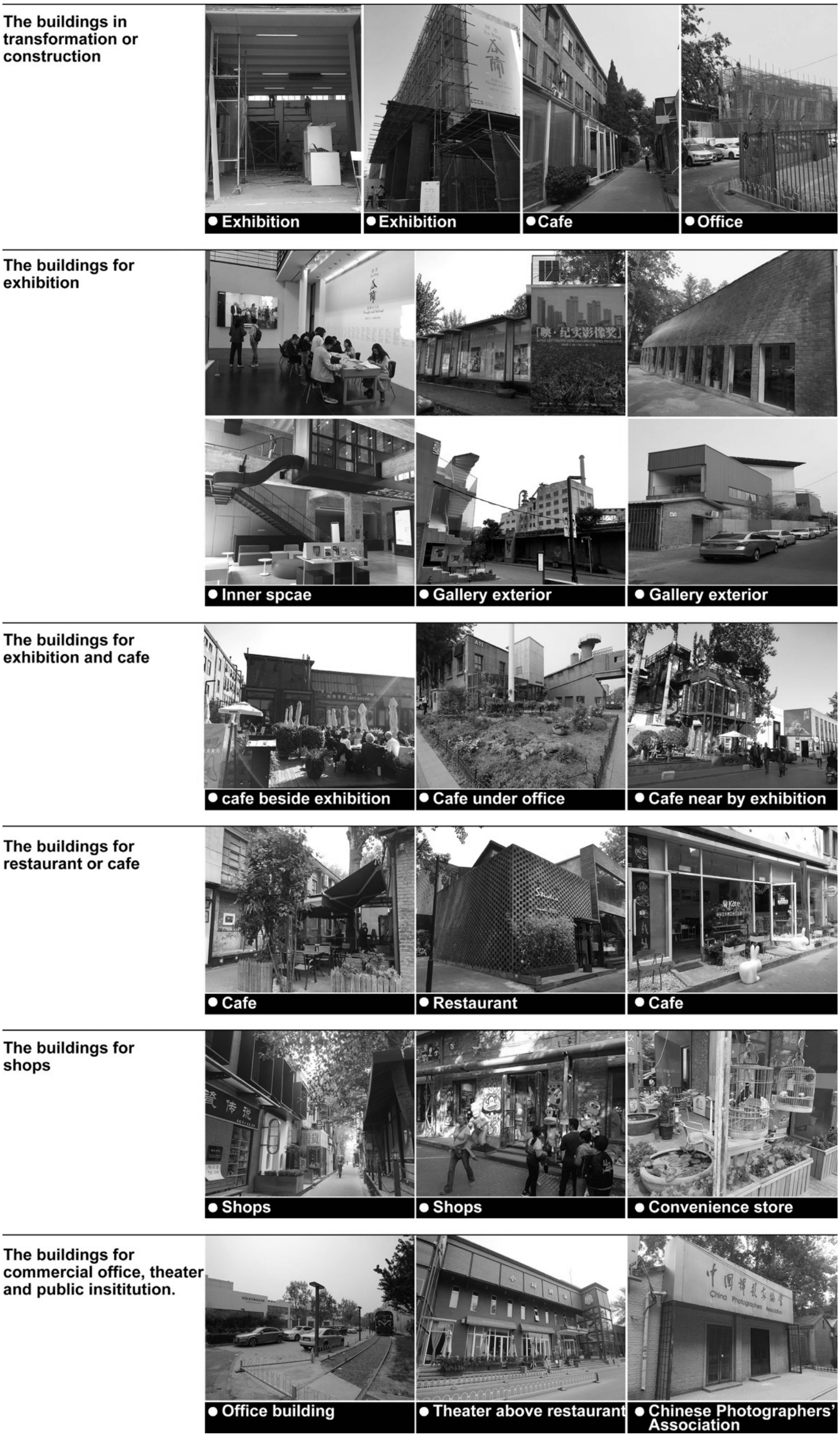


Figure 6.49. The photos of 798 heritage area. Photos taken by the author between 2017 and 2019.

In the space transformation of 798, a specific user-space matching between the tenants and heritage spaces played a significant role in the creation of the land use mix. According to the managers in 798, spaces in different areas have different rents. Those private managers of the art/design studios, galleries, shops, restaurants and other companies also have different preferences regarding their location in 798. In the space matching process above, the integration of the compact functions was derived from the free space selection by those new art/design studios or companies. **This also reflects one feature of the bottom-up oriented space transformation in 798: the highly mixed and compact land uses without any zoning plan.** The land use mix of 798 industrial heritage area illustrated in figure 6.48 is distinctive from that of the campus CICs in Beijing. The campus CICs have a zoned land use mix to support their high population density. In contrast, in the 798 heritage area the user-space matching mechanism gave the artists, designers or managers of private institutes some choice in the selection of spaces in 798. Due to the expiration of the zoning plan of the original enterprise CIC, the spatial transformation of each building was in accordance with the preferences of the space users.

Another bottom-up space transformation feature in changing the functions of industrial heritages is the high social mix and free activities of tenants in the spatial transformation. Though safety regulations exist for renovating buildings for specific functions, which were required by the managers of 798 according to National Law of Safe Production, the imaginative artists and designers fully exploited the possibilities when renovating their buildings. During this process, the social relationship of neighbourhoods in 798 became increasingly complex and socio-spatial interactions were also enlivened. Not only artists and designers but also other individuals from non-governmental organization (NGO) and commercial services were engaged in art-related and leisure businesses in the industrial heritage spaces. The increasing number of visitors gave the new renters a higher incentive to seek more attention. Therefore, 798 became a storehouse of various novel environmental design works. Even in present day, visitors can still find many builders working on space transformation projects in preparation for new gallery exhibitions or for service facilities.

In 2007, a new round of top-down oriented regenerations of the industrial heritage area had been carried out to project an image of the city for the 2008 Olympic games in Beijing. Without the original industrial production, the rents became a main source of income for 798 Art District. Despite the rent increases, the free market based user-space matching process still functions for integrating tenants who have stronger capital strength. High value-added enterprises began to move into 798, gentrifying the area. The new buildings constructed inside and on the boundary spaces were occupied by high-tech enterprises. Moreover, new high-end restaurants in 798 also reflected the "upgrading" of the industrial heritage area.

The managers of 798 also referred to a new zoning plan for future development, to reclassify space functions developed during the bottom-up transformation. The art-related activities will be located in a "山" shaped zone, which suggests the management want to concentrate specific functions in a top-down oriented transformation in the near future (see Figure 6.50). In addition, a new art action centre was planned for construction near the art zone, to promote the art trading platform in 798. New public facilities including a large multi-story parking lot were also planned for the heritage area. Wang Yanling also plans to construct the largest children's gallery within 798. In the early development of 798, the bottom-up oriented transformation played a significant role, but today the development of 798 is primarily directed with the top down. However, the high mixed land use still supports a broad population with a high vibrancy, a prominent feature of 798.

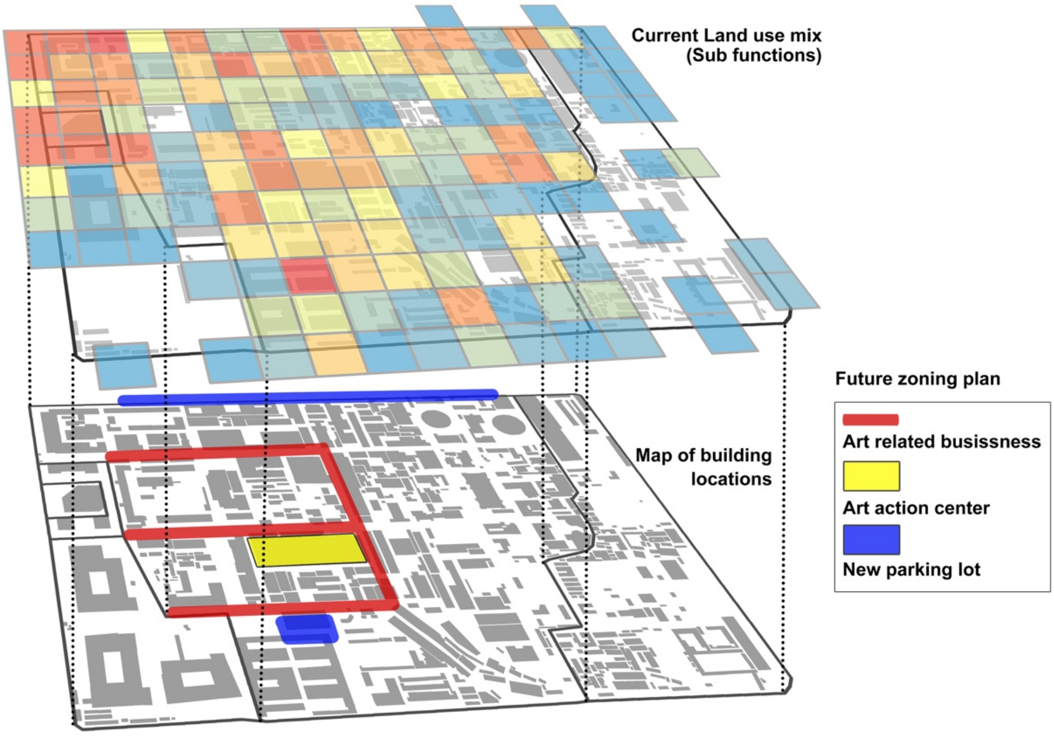


Figure 6.50. The new zoning plan from the managers in 798 and the land use mix map with 80 x 80 meters' grids. Figure drawn by the author.

6.4.4 The top-down oriented spatial transformation employed for later development projects: the pursuit of an urban production space for emerging industries

• Laijin: top-down oriented functional zoning and restriction on building transformation

Beijing No.2 Textile Factory *精棉二厂* was a state enterprise which had its own CIC with working and living areas. The residence area is on the north and the manufacture plant on the south of the road. Figure 6.51 shows the CIC life established by the enterprise before 2006 had a job-housing balance with a land use mix which met almost all the local individuals' requirements for public services including health care, education, commercial services, restaurants, and entertainment. The close tie among colleagues in the same work unit also created an acquaintance community inside the CIC, which also influence those seeking jobs (Bian, 1997). In state enterprises, the descendants of workers inside CICs would have a better chance of being employed by their parents' work unit when they graduated from middle school or the local technical schools inside the CIC. As a member of a work unit, an individual also had the right to house within their work unit (Logan et al., 1999b, Li, 2003), which reinforced the close relationship between different generations inside the CIC.

The collective life inside the CIC of an urban enterprise was gradually undermined after China decided to start its economy reform and open its market to the world in 1978. Beijing No.2 Textile Factory also experienced a hard period of suffering after the market reform of 1992. This work unit was reorganized in 2006 which led to many of the original 10000 workers losing their jobs. In 2011, the south part of the enterprise was transformed into an industrial park (Laijin Culture Creative Industrial Park *莱锦文化创意产业园*). After that, there was a real split in spatial life between the residential and working areas in this CIC, where the people who mainly worked here would no longer be the people who lived here. With the new transformation adapted to the market reform, the building heritages of both sides of the original CIC were preserved. During this process, the industrial heritages in the south experienced a top-down oriented regeneration, which brought the new vitality to the abandoned urban fabric by attracting emerging industries.

The Laijin Culture Creative Industrial Park, located 3 km to the east of the new CCTV building, was also close to the office buildings of BTV and People's Daily. This location contributed to the transformation of Laijin, which became a popular location for media, design and entertainment companies. The preservation and transformation project in Laijin took place eight years after that of 798, so Laijin learned from the experience of 798. A top-down plan was employed in Laijin. In contrast to 798, Laijin did not need to counter-balance any bottom-up oriented transformation, which led to the quick construction of a building designed by Kengo Kuma with a unified design language and image. The project was completed in 2013. The only distinct changes to the original design by Kengo Kuma appeared in the north commercial boundary spaces. A comparison between figure 6.52 and figure 6.53 reveals that the original buildings on the north boundary were all replaced by an L-shaped commercial service building (see Zone A in figure 6.54). Behind the new commercial boundary spaces, the renovated heritage buildings became homes to offices. Around the preserved buildings, Kengo Kuma design 16 new multi-floor office buildings. Those five-floor buildings increased the space diversity and public space area, which also increased the number of rents for Laijin. Zhu, a manager of Laijin, affirmed that the floor space ratio was still around 1 at the conclusion of the project, which was limited by an industrial land-use zoning regulation.

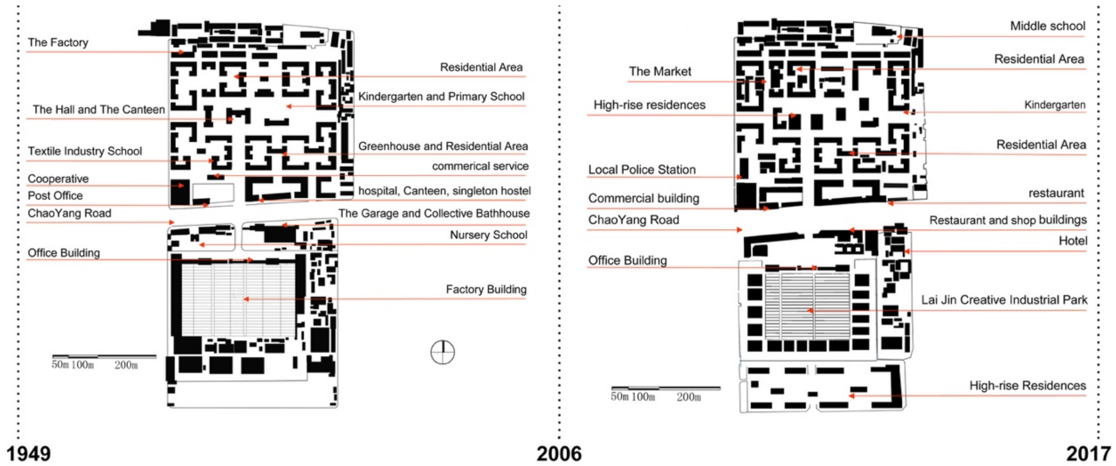


Figure 6.51, The map of the original CIC of Beijing No.2 Textile Factory before 2006 (Left) and the map of CIC transformation after 2006 (Right). Figure adapted from (Zhang, 2004, Zhang et al., 2009c, Gu, 2013) by the author.

The land of the original east and west factories (Beijing No.1 Textile Factory and Beijing No.3 Textile Factory) near Laijin were sold to commercial developers (see Figure 6.60). However, the low profit from constructing schools and kindergartens on a large proportion of the land hindered further commercialization of Beijing No.2 Textile Factory. Then only a smaller southern part of the plant was separated for a land use change. The income from land transfer to commercial residence project in the south were used to fund the north-side transformation project of Laijin. Economic considerations, limited by the regulations on land use change, led to new land transformations/uses (transform the existing factory buildings into public service/office spaces keeping the industrial heritage features) in Laijin (see Figure 6.52, 6.53 and 6.60).

Figure 6.52. The 3D illustration of original design by Kengo Kuma. Figure © Laijin culture creative industrial park.

Figure 6.53. An overview of Laijin Culture Creative Industrial Park. The road on the left is Chaoyang with an eastly direction. Photo taken by the author in 2018.

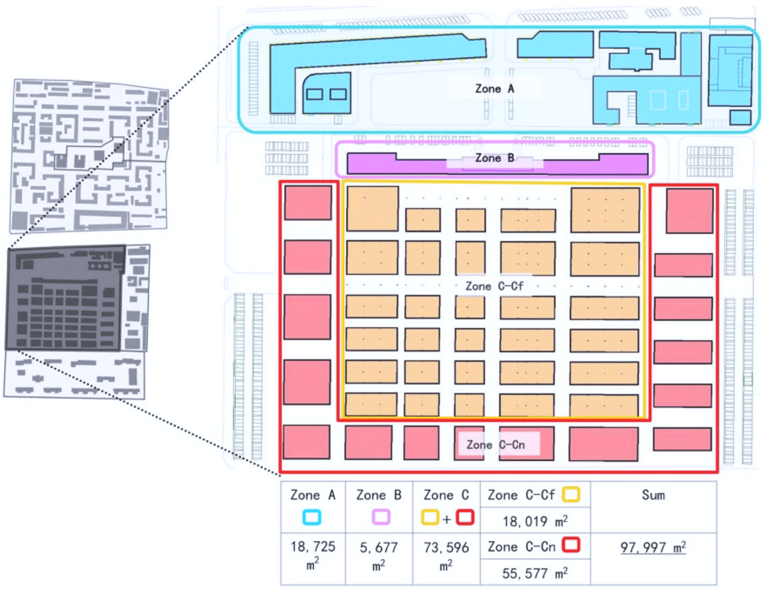


Figure 6.54. The available floor area in different zones of Laijin Culture Creative Industrial Park after completion of the transformation project. Figure adapted by the author based on the resource © Laijin Culture Creative Industrial Park.

Zone		**Room size (m^2)**	**Function**	**Building**
A		140~1,200	Public service	New
B		50~60	Small office	Heritage
C	**Cf**	300~1,000	Small/Middle office	Heritage
	Cn	2,000~5,000	Big office space	New

Table 6.8. The attributes including room sizes, main functions and classification of new and heritage buildings in the Laijin zoning plan. Table drawn by the author © Laijin culture creative industrial park.

For Laijin, the main difference with 798 was the land use zoning early in the heritage transformation, which also led to a contrasting transformation logic in the arrangement of mixed-use spaces. Most of the restaurants, shops and hotels were located in Zone A (see Figure 6.54) and in the boundary space buildings (later transformed industrial buildings) in the east of Laijin (see Figure 6.44 and 6.55). Similar to 798, these border spaces face outward to serve the individuals inside Laijin as well as the public. On the other hand, most heritage buildings and those newly constructed buildings were classified in the office zone B, Zone C and also the nearby yard in the east later-developed boundary spaces. In contrast to 798, Zone C of Laijin has an independent enclosure-gating system, within which those listed companies, whose shares are bought and sold on the stock markets, were segregated from the outside public. The zoning plan also creates an industrial club effect for the companies renting in Laijin, which in turn supports the enclosure-gating system.

Zhu of Laijin explained that the areas in the office building also differ from each other in different zones. The heritage buildings have mainly been converted into room from 50 m^2 to 1000 m^2 for small- and middle-sized offices (see Figure 6.54 and Table 6.8), while the newly-built multi-layer office buildings (in Zone C-Cn) have the rooms with larger areas for listed companies.

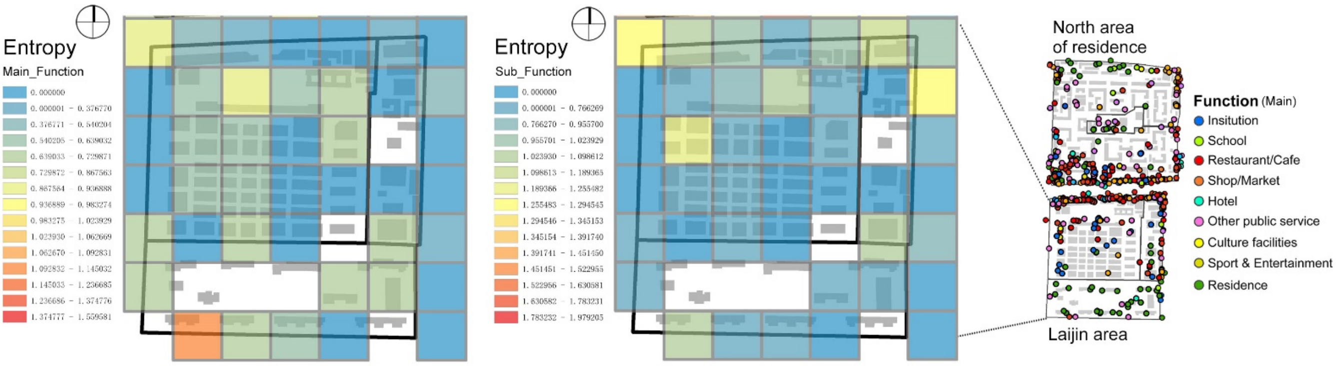


Figure 6.55. Land use mix (entropy) of Laijin Culture Creative Industrial Park (the south production spaces of original CIC for Beijing No.2 Textile Factory) in 2016. The entropy of main functions is distinct from that of sub functions. Moreover, the later one has a closer relationship with the spatial vitality (based on the locations of high densities in Figure 6.45 and the mixed-use spaces in Figure 6.55). Grid size: 80m x 80m. Figure drawn by the author.

In the zoning plan for the Laijin heritage area, most of the service functions were situated in the boundary spaces where the land use mix was higher (see the entropy with sub-functions in Figure 6.55). There were higher population densities during the week inside the Laijin industrial heritage area, where there were mainly office buildings, than on the weekend (see Figures 6.45 and 6.46). In contrast, the population densities of industrial heritage areas (Laijin_IH) were much higher than that of the whole CIC area (Laijin_area) between 10 am and 6pm on weekdays. Moreover, the population densities of Laijin_IH were the highest during normal working hours among the three study cases, which shows the industrial space transformation in Laijin was more fully exploited for single office functions than in the other two. On the other hand, the boundary spaces of Laijin, especially the north part, attracted a large crowd of people due to its comprehensive service functions including restaurants, cafés, barbershops and convenience stores open the whole week. The quiet environment inside Laijin and busy boundary spaces also reflects the opposite effects to that in 798, where the inside area has quite large numbers of people especially at the weekend. One reason for this difference is that the heritage area preserved in 798 is about 5.5 times larger than that in Laijin[33]. The larger area and earlier transformation would always host more activities which are not limited by later zoning regulations, though complicated management problems sometimes did arise.

Besides the zoning plan enforced by the top-down management from original work unit CIC, more rigid regulations were in place to limit the space transformation practice by the private commercial enterprises renting offices here. The interior design of the buildings

[33] The area of the industrial heritage of 798 is about 0.652 km^2 and that of Laijin is about 0.119 km^2.

was not limited for heritage structure, while the building facade could not be changed. Without a bottom-up oriented transformation, like that in 798, the exterior in Laijin is much more unified and orderly (see Figure 6.56).

Figure 6.56. Photos of Laijin Culture Creative Industrial Park. Photo taken by the author between 2017 and 2019.

• 898 Innospace: a new transformation project with a top-down oriented approach to revitalizing the deteriorated modern CIC space

898 Innospace *八九八创新空间* was created from the industrial CIC of a declining work unit, Beijing East Suburb Grain Depot *北京东郊粮库*. In 2016 898 was in the intermediate stage in the land use transformation process. In figure 6.57, almost all the boundary spaces had been transformed into new commercial service, office and residence locations. The heritage areas in the middle and southwest of the original CIC were left substantially undeveloped, with only a few new office buildings constructed there. In the same year, the 898 Innospace began to advertise the spatial transformation in the heritage area.

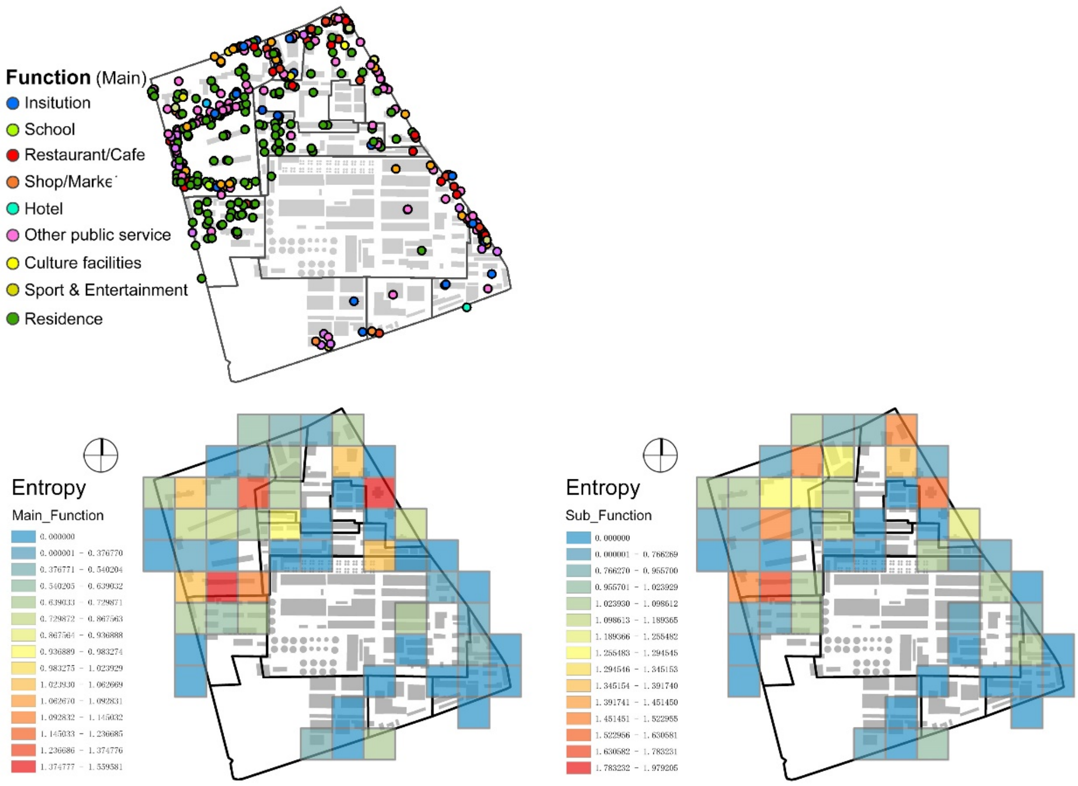


Figure 6.57. Land use mix (entropy) of 898 Innospace in 2016. Land use mix is higher when the entropy is higher. Grid size: 80m x 80m. Figure drawn by the author.

In contrast to 798, the transformation of the industrial buildings of Laijin and 898 were both managed from the top down. However, since losing the original integrity of CIC space, all three industrial preservation parks have relied much more on participants from the public to enliven their inner spaces. In the urbanization resulting from 1992 market reform, many of the CIC boundary spaces were integrated into the urban public service environment earlier. In figure 6.58, the lack of points of interest (POI) inside the heritage areas of 898 in 2016 reflects the same space transformation sequence as that in areas of 798 and Laijin.

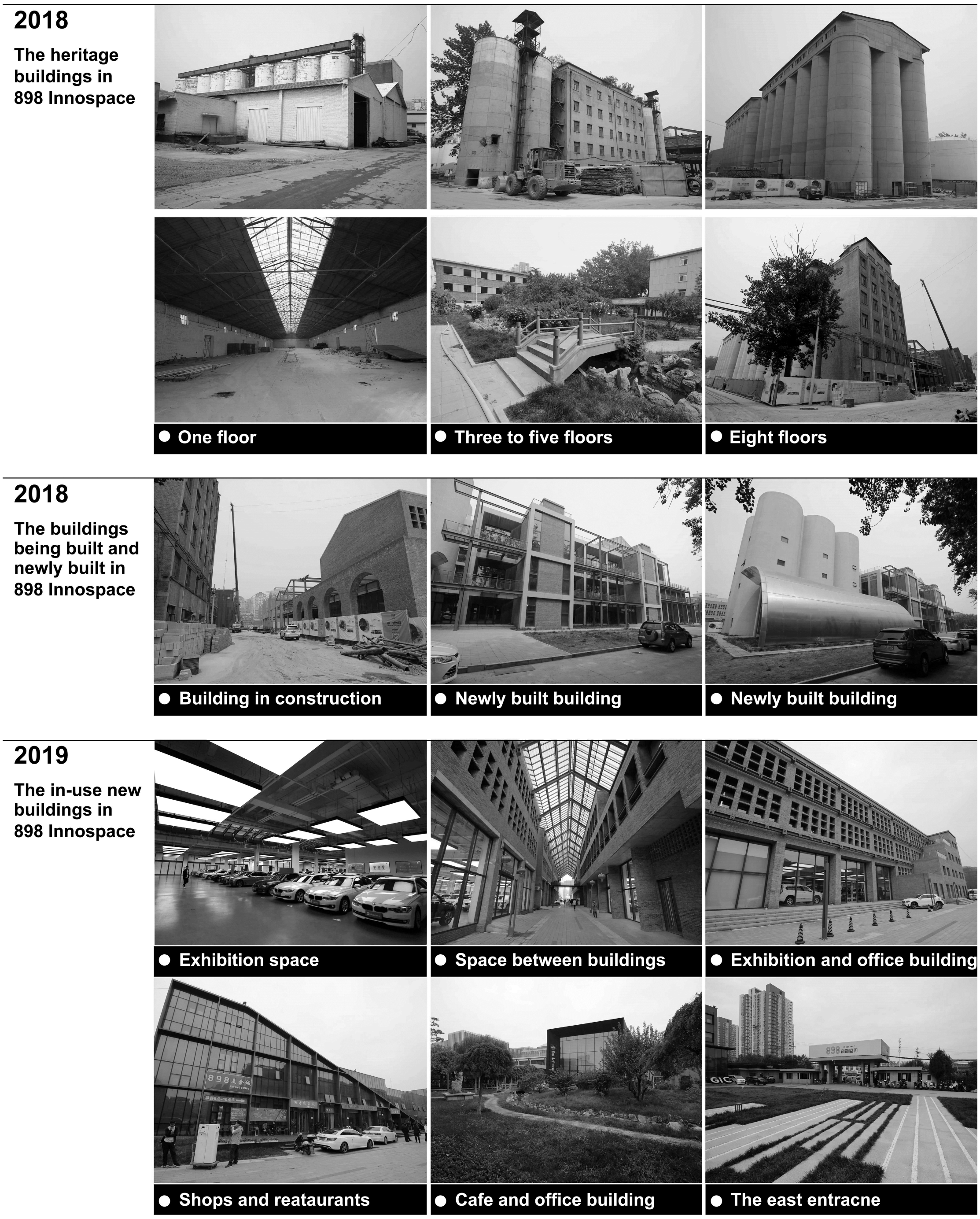


Figure 6.58, Transformation of spaces in 898 Innospace in 2018 and 2019. Photos taken by the author.

6.4.5 The local spatial evolution of daily residence life next to Laijin: after the division of residence and working areas in the original enterprise CIC

Accompanied by the 'Socializing Social Welfare' policy (Ding, 2011) in the enterprise reform, work units on the verge of bankruptcy were relieved of some of their responsibility for supporting the local collective public services. Lacking the vertical support from a state enterprise, there was little impetus for transforming residence areas and the condition of the old buildings and infrastructures declined over time. In the end, the local street offices and local residents' committees began to shoulder the burden of the spatial management instead of the work unit (Lu, 2006, Huang, 2006, Bray, 2005). Therefore, the spatial transformation of working areas and residence areas was split, suggesting that the residence-work area balance of CIC life style had been lost. Thereafter, an increasing number of the people in the residence area no longer worked in the nearby working areas, which were closing and where more and more private enterprises were thriving in renovated buildings.

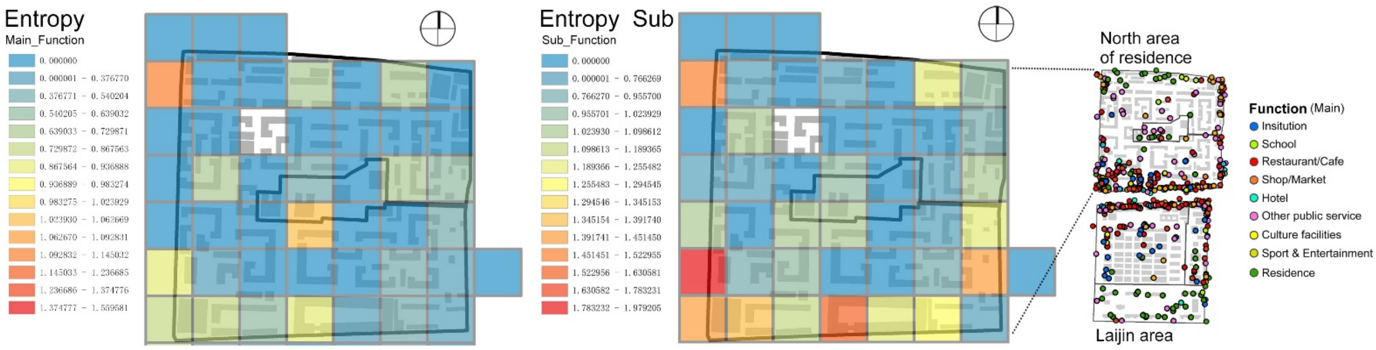


Figure 6.59. Land use mix of the residence area in the north of the original CIC for Beijing No.2 Textile Factory. Grid size: 80m x 80m. Figure drawn by the author.

Figure 6.60 shows how the CIC of Beijing No.3 Textile Factory has been transformed into commercial areas with high FAR. In contrast, the CIC of Beijing No.2 Textile Factory still has a low FAR. Moreover, the CIC residence area of No.2 Textile Factory on the north of Chaoyang road preserved a large number of old residence buildings where the work unit members still live. Compared to the industrial transformation of Laijin in the south, the spatial transformation of the residence area in Beijing No. 2 is slower due to the disruption of original independent production and consumption. Except for the replacement of an assembly hall by high rise commercial buildings in the centre of the residence area, much of the infrastructure there is the same as before the 1990s. Figure 6.59 shows that the land use mix of the south borders were much higher than that of the inner space of the residence area. There was also commercialized buildings on south and west borders, where the space use vitalities were also higher than the inside spaces (see Figure 6.45). However, with the transformation of the new market reform, the integration of new public services and construction of new high-rise buildings, the areas close to the centre axis inside the residence area also became vibrant during leisure time (6 am, 6 pm and 8 pm).

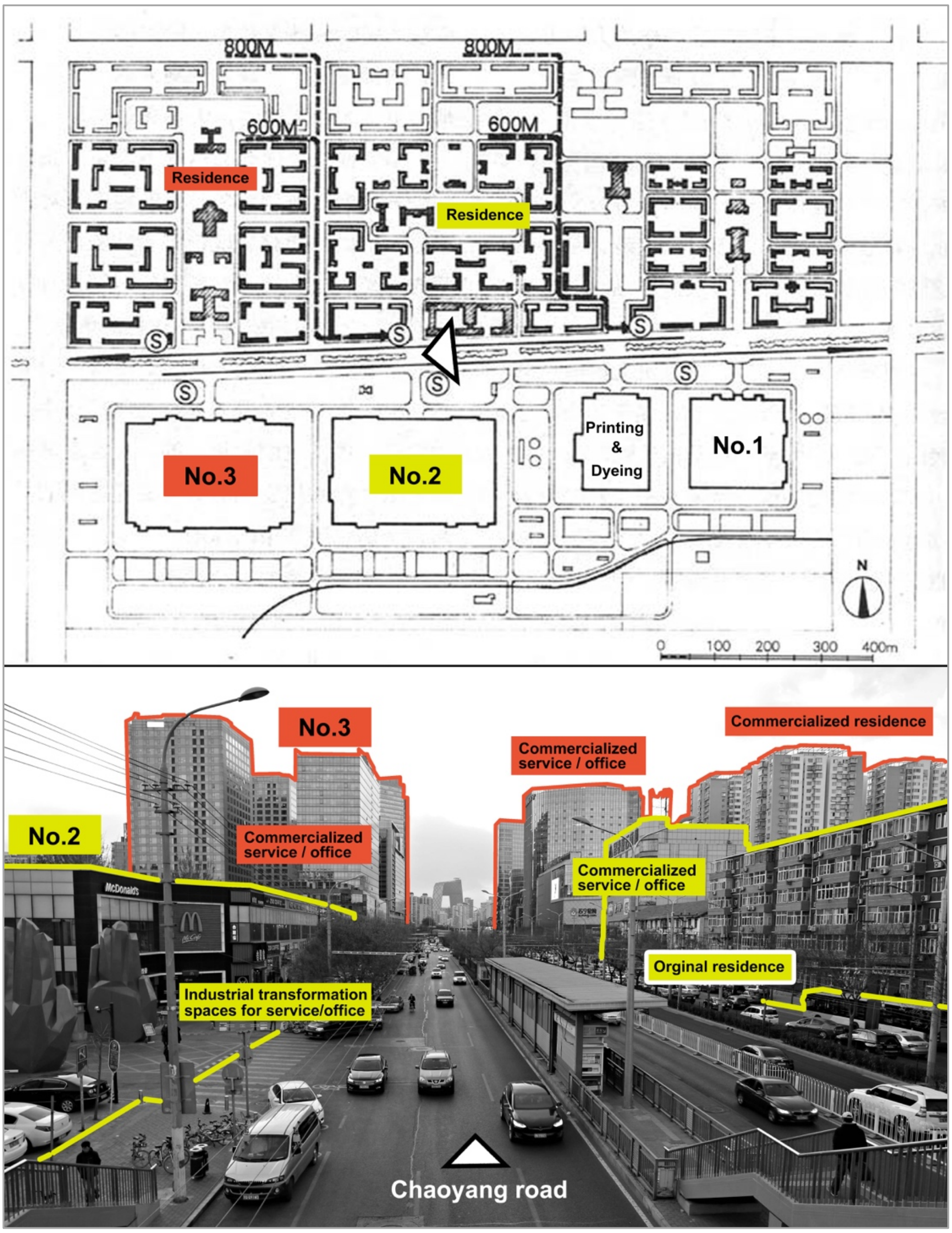


Figure 6.60. The original planning map of some enterprise CICs before 1990s and the photo of their current development and transformation. **Top figure**: the original map of enterprise CICs for Beijing No.1 Textile Factory, Beijing No.2 Textile Factory, Beijing No.3 Textile Factory and Beijing Printing & Dyeing Factory, all constructed before 1978. **Bottom photo**: the current juxtaposition of commercial service buildings (left) and residence buildings (right) on each side of Chaoyang road in present day Beijing. Original map © (Zhang et al., 2009b). Photo taken by the author in 2019.

The population densities of the residence area of Beijing No.2 Textile Factory (RH_to the north of Laijin in Figure 6.46) remained higher than that of the surrounding urban environment. Except the working time, the population density of residence area was also higher than the new industrial spaces of three selected enterprises.

Figure 6.61. The temporary market street in the residence area of an enterprise work unit in 2017. Behind the shabby market are the new high-rise residential buildings. Photos taken by the author in 2017.

Figure 6.62. The transformation of space use in the residence area to the north of Laijin. **Left** : an old abandoned building in 2017. **Right**: In 2018, the building has been transformed into one entrance of the market with several shops inside it. Photos taken by the author.

Figure 6.63. The middle entrance of the new market after the transformation of the old buildings in 2018. Photo taken by the author in 2019.

Figure 6.64. The inside views of the market after the transformation of the old infrastructures. Photo taken by the author in 2018 and 2019.

In Figure 6.61 and 6.62, the market inside the residence was along a shabby street in 2017 and the large number of stalls made it as a temporary site for the residents to buy goods. Even in the middle of winter, the grocers came here every day; some of them came from the suburbs. Instead of the original work unit, the street office and residents' committee played a significant role in local management and converting the building for local needs. In 2018, to resolve the chaotic state of the market, the old buildings along the shabby market street were transformed into a new interior market, with shops and a restaurant. All the service functions were moved into interior spaces, where the opening hours were then extended (Figure 6.62-6.64). In the restaurant, close to the southwest gate of the residence area, a quick meal costs 1.5 to 2.5 euro (Figure 6.65). In contrast to higher prices in restaurants in zone A of Laijin, the lower prices in the market and in the restaurants reflect the gap of living standards produced by the transformation of modern CIC spaces.

Fanju Restaurant (饭局餐厅) Price_RMB		
Zhizi Barbecue of Multiguest Set	Original price	Favourable price
For two people	207	128
For four people	313	218
Hotpot of Multiguest Set	Original price	Favourable price
For two people	230	138
For four people	344	208

Fried dish + Steamed Rice	Price_RMB	Fried dish + Steamed Rice	Price_RMB	Fried dish + Steamed Rice	Price_RMB	Noodles	Price_RMB
Fried eggplant	12	Fried eggs and rice	10	Fried beef with potatoes	16	Noodles with tomato and egg	12
Mapo doufu	10	Fried rice with soy sauce	12	Stir-fried lamp with chines leek	20	Noodles with fried chilli & pork	12
Fish flavored pork slices	14	Yangzhou fried rice	14	Chilli scrambled rice	14	Noodles with braised beef	18
Fried chilli & potato slices	10	Fried rice with beef	16	Fried Moo Shu Pork	14	Noodles with pork and press vegetable	12
Kung Pao Chicken	14	Chinese chives scrambled eggs	12	Fried sauce noodles	15	Spinach egg noodles	12
Twice-cooked pork	14	Onion scrambled eggs	12			Noodles with fried eggplant	12

Figure 6.65. A restaurant in the residence area of Beijing No.2 Textile Factory and the prices of dishes (1 euro is about 6.8 RMB). Photos taken by the author in 2018.

To some extent, the living standard of the residence area of Beijing No.2 Textile Factory, which is called Dong Ba Li Zhuang community *东八里庄小区*, is as low as that in the campus CICs, where the social mix of students and teachers with different backgrounds live together. In Dong Ba Li Zhuang, the retired/unemployed workers, their families and renters from the public also form a social mix. In particular, the relative low rents due to shabby state of residence buildings and high rents in the new high-rise buildings provide homes to individuals from different social classes, which in turn leads to a high social mix in the residence area.

Zhu, manager of Laijin, said that the work unit employed the same management company (mainly in charge of security, sanitary cleaning and infrastructure maintenance) for Laijin and the north original residence area. Some of the income from Laijin was also redistributed to guarantee the retirement benefits of about 10,000 original enterprise workers, which suggests the last links between the work unit and the workers. However, the split of welfare, consumption and production in original CIC suggests that Laijin cannot dominate the space development of the residence area on the north of Chaoyang road because they have lost the deep socio-spatial connections with each other that based on the collective and independent management. The same situation also appears in the CIC residence areas near by 789 and 898. Moreover, the environment regeneration demands of the residents in the north of Laijing for a period of years also demonstrates that the street office and residents' committee do not have as much capability to organize the large-scale construction as the original work unit system does.

6.5 The preservation and reconstruction of pre-industrial walled cities within the modern urban areas: CICs mainly driven by single tourist economy

6.5.1 The ancient city of Pingyao: a world heritage site for both cultural protection and tourism

In China, some pre-industrial cities/towns which had a lower level of administration than the capital city Bei'jing were preserved after 1949. The ancient city of Pingyao *平遥古城* in Shanxi province has well-preserved traditional buildings as well as pre-industrial city walls and gates. The ancient city of Pingyao did not have an ancient CIC structure. The urbanization after 1949 has transformed the Pingyao ancient city into a modern CIC. In 1997, the ancient city of Pingyao became a World Heritage Site and in 2015 it became a national 5A-class tourist attraction. Benefiting from the tourism development resulting from the preservation of its heritage, Pingyao could reverse its economic fortunes, which have fallen due to the decline of the coal industry, once a traditional pillar of the economy in Shanxi province.

Figure 6.66, A bird view photo of the south wall of Pingyao ancient city. Photo taken by Yanyan. Resource © 2000-2019 XINHUANET.com (Link: [http://www.xinhuanet.com/fashion/2019-05/09/c_1124464201_6.htm)](http://www.xinhuanet.com/fashion/2019-05/09/c_1124464201_6.htm)

In contrast to work units, the typical modern CICs, Pingyao cannot be defined as a typical Chinese CIC, because it has no collective production and consumption based on local independent socio-spatial management. On the other hand, the preservation of ancient city of Pingyao is based on the successful experience from the European cities. Before Pingyao, a large number of ancient cities have been preserved in developed modern urban areas in other parts of the world. For example, the inner city of Regensburg in Germany (about 1.68 km^2 measured in Google maps) is surrounded by large modern urban areas (about 47 km^2 measured in Google maps). Compared with the well-designed new urban areas in Regensburg, the urban areas around the ancient city of Pingyao in present day is only about 10.8 km^2 and the old town accounts for 2.5 km^2 measured in Baidu map.

The tourism-driven economy in Pingyao also relies heavily on the consumption of culture, services and entertainment by tourists. The GDP of the whole Pingyao area in 2018 was 11.87 bn RMB, which includes 1.21 bn RMB for primary industry, 3.92 bn RMB for secondary industry and 6.74 bn RMB for the tertiary industry (Statistics Bureau of Pingyao County, 2019). The large proportion of the tertiary sector (56.8%) in the GDP also shows the significant importance of the ancient city in fiscal revenue and residents' income. To some extent, Pingyao functions as a large heritage-tourism community, where most of the local residents benefit from the service sector. They run hotels, shops as well as restaurants. Compared with the collective production and consumption in modern work unit CICs, the production and consumption via a single service sector in Pingyao mixes individuals with different social backgrounds and from different areas. Simultaneously, the high mobility of tourists creates a variety of public interactions in a temporary social relationship. What happened in the present day Pingyao ancient city is more like that in 798 Art District, where the typical Chinese CIC life has been destructed.

In contrast to the self-sufficiency in modern CICs with regard to municipal governance, Pingyao is a county under the governance of the city Jinzhong *晋中市*. The Management Committee of Pingyao Ancient City *平遥古城管委会* is also led by Jinzhong municipal government. Moreover, the socio-spatial governances of Pingyao ancient city and the surrounding urban environments are not so independent from each other. The gates of the ancient city do not limit public visits, which creates a much more permeable and integrated environment between the heritage area and surrounding urban areas.

Figure 6.67and 6.68 reflect the low space use vitality of ancient city of Pingyao in contrast to it surrounding urban environments, which indicates that the space use in the ancient city is distinct from work units, typical Chinese modern CICs. Due to the generally low FAR ratio in the heritage area, the even population densities in the ancient city are 1300-3600 people/km^2 in specific hours in working time (10am) and leisure time (6pm and 10pm) during the week and at weekends. Though during statutory holidays the population density in Pingyao ancient city became higher, which stimulated the space use, during other normal times the space use in ancient city does not have the same vitality. Moreover, during the whole week, the ancient city has a lower population density than the surrounding urban environments. In figure 6.67, almost all the highly vitalized urban areas are located in the surrounding modern urban areas. The population densities of the modern urban areas are between 2300 and 5700 people/km^2, which are much higher than that within the ancient city.

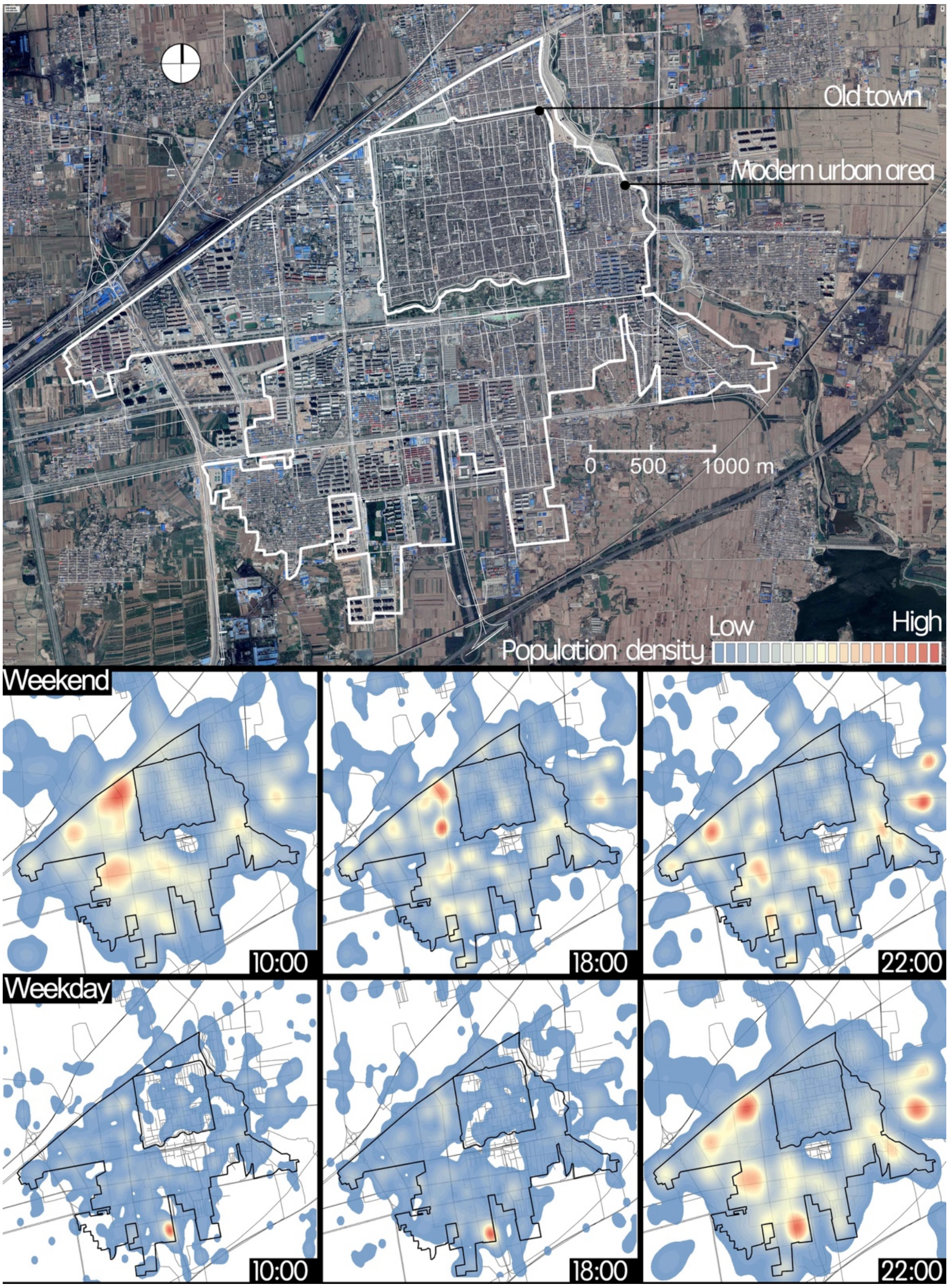


Figure 6.67. The heat map analysis of population densities for heritage area (Old town) and surrounding modern urban areas of Pingyao in November 2019. Figure drawn by the author based on the maps © Google earth map, Open street map, Tencent map and Baidu map.

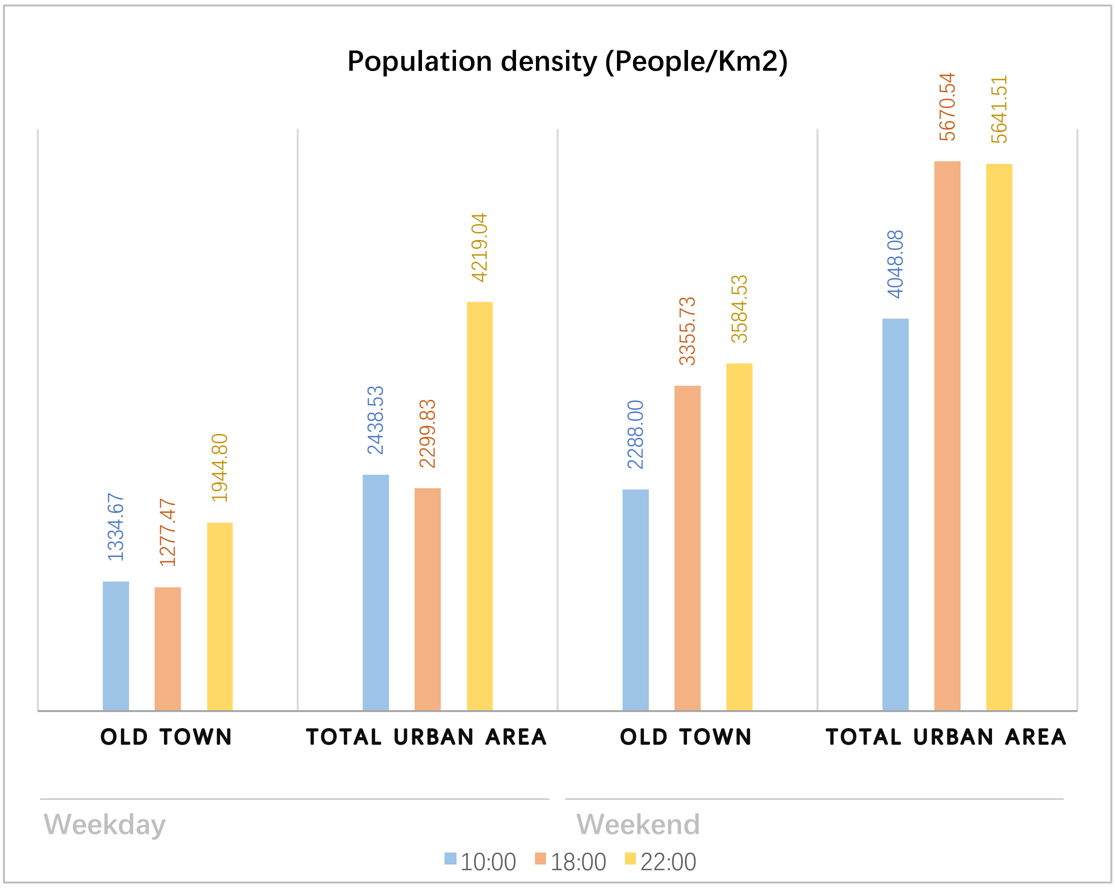


Figure 6.68. The real-time population densities of different areas in urban districts of Pingyao in November 2019. Figure drawn by the author.

The population densities of different areas in Pingyao at the weekend are much higher than that on weekdays, which suggests many tourists come to the old city at the weekend to spend their leisure time there (Figure 6.68). In figure 6.67, the population distribution during the day at the weekend in Pingyao is more concentrated, which reflects a higher space use vitality. However, the highest vitalities are distributed outside the ancient city, which is also a very distinctive feature to those modern CICs for work units in Beijing. This is one reason to rule out Pingyao ancient city from typical Chinese CICs in present day. The single tourism industry dependent on the municipal governance as well as the low FAR ratio determined the space use in Pingyao cannot form a collective life style to integrate the working and living for all the individuals as that realized in a typical Chinese CIC. The ancient city of Pingyao functions as a "museum CIC" for exhibiting the ancient city life or a leisure CIC for entertaining public people, but not a typical Chinese CIC. A typical modern CIC in China is heavily relied on the combination of working and living areas to create a job-housing balance for CIC members. Even though the spaces inside a modern CIC cannot be easily shared with the outside public, there is less waste in space uses inside CICs because of relatively fully stimulated space uses by high population densities.

6.5.2 Reconstruct the ancient city of Datong: a replacement of the modern urban life built after 1949?

Datong, the second biggest city in Shanxi province, is also a city driven by both secondary and tertiary industries. During the 10th Five-Year Plan from 2001 to 2005 in Datong, the contribution of the secondary industry to the GDP was 51.2%, which was higher than the primary industry (5.4%) and the tertiary industry (43.4%) together. The coal industry alone accounted for 28% of the GDP of secondary industry, and the GDP of tertiary industry, the coal-based transportation accounted 30% of the GDP added (Cao, 2014). Therefore, the GDP of secondary industry was higher than the tertiary sector in Datong before 2013 (Figure 6.72).

	Taiyuan	Datong	Changzhi	Linfen	Yuncheng	Shuozhou	Xinzhou	Lvliang	Jinzhong	Yangquan	JIncheng	EVEN
GDP growth	8.5	8.6	-4.2	-3.9	-1.3	-4.6	-1.1	-6.1	4.7	-4.5	3.1	2.7
Fiscal growth	12.3	7.3	-32.95	-27	-0.3	-40.95	-19.2	-39.6	-18.7	2.7	-3.6	-7.8

Table 6.9. The GDP/Fiscal growth (%) of cities in Shanxi during the first half of 2015. Resource © (Gao, 2015).

Figure 6.69. The demolition of new high-rise residences (outside the old town) to reconstruct the ancient enclosure and gating system as well as landscape belts surrounding the ancient city of Datong. Photo taken in August 2016 © China Daily / Reuters.

The overcapacity and lack of demand for coal on the market dramatically reduced most of the cities' economic growth in Shanxi province. Only two cities had growth in both GDP and public finance in the first half of 2015, one of which was Datong (Table 6.9). The economic transformation contributed to the growth of Datong. One of tactic was to expand the tourism industry by promoting the ancient city Datong, based on the successful experience of Pingyao ancient city. Shanxi province still had a huge number of ancient buildings dating from medieval to pre-industrial China, and Datong was a significant city for military defence as well as a political centre in ancient times. However, in contrast to Pingyao, the heritage of ancient city Datong was not completely preserved after 1949. As shown in figure 6.70 and figure 6.71, the ancient city walls had been dilapidated during 2006 and 2009. In addition, modern multi-story buildings were densely built inside and outside the city walls after 1949. The traditional court yard houses inside the ancient city were also in a bad state of disrepair.

The fate of Datong ancient city changed dramatically due to the arrival of the new mayor, Geng Yanbo, in 2008. He started a huge project to promote Datong by repairing the ancient city, constructing new urban road systems as well as transferring the residents living in shabby houses within ancient city to the newly built residences in surrounding urban areas. However, these were formidable tasks because there were 188,000 homes inside the ancient city that needed to be demolished and those living in them had to be resettled, which led to different kinds of difficulties, among them a huge social controversy. For constructing the green belts and moats surrounding the ancient city walls, a large number of buildings outside the ancient city walls were removed. Even newly built high-rise residences outside the ancient city walls were flattened to clear the area (Figure 6.69). In 2013, Gen Yanbo left Datong and his successor took responsibility for reconstructing the huge city wall system. Before Gen left, about 160,000 homes were demolished and their inhabitant were moved to new residence buildings outside the ancient city.

Figure 6.70. Analysis of the rebuilding process of the ancient city Datong from 2009 to 2019. Figure drawn by the author based on Google historical map.

In the right figure 6.71, the relationship between the repair[34] of the ancient city wall and the removal of nearby residence buildings are revealed in satellite photos taken in different years. In contrast to modern CICs for work units, the walls of Datong ancient city mainly function as a public space to remind the memory of the ancient life. The ancient city gates are also totally open to public transportation. Moreover, the transformation projects to replace the dilapidated buildings with new courtyard houses, commercial streets as well as repaired temples subverted the original local life established after 1949. In contrast to Pingyao ancient city where local indigenous residents still live inside the ancient city, Datong emptied the houses inside for the reconstruction work. Even though the government explained the shabby and dangerous living conditions inside the ancient city had to be changed, the public critiques on the rude demolition did not stop. The municipal government of Datong has the total administrative jurisdiction in the transformation project of ancient city, which contributed to the quick redistribution of the ancient city residents in the surrounding urban areas. This is also distinct from the independent relationship in socio-spatial governance between the modern CICs and their surrounding urban areas. A large number of residents praised the performance of the Mayor Geng Yanbo. To some extent, the desire for an improvement in living conditions as well as the tradition of the collectivist spirit are mingled within the transformation project of the ancient city.

Figure 6.71. The reconstruction process of the ancient city wall and gating system (the south west wall and gate in this figure) of Datong from 2009 to 2018. Figure drawn by the author based on the Google historical map.

[34] To some extent, due to the decay of the ancient city walls, the repair work constituted a large proportion of the reconstruction projects. In 2016, the government finished the repair work. The repaired city wall is 7.24 km long and 18 meters wide on the bottom. There is a 12-meter-wide trail on the top of the wall.

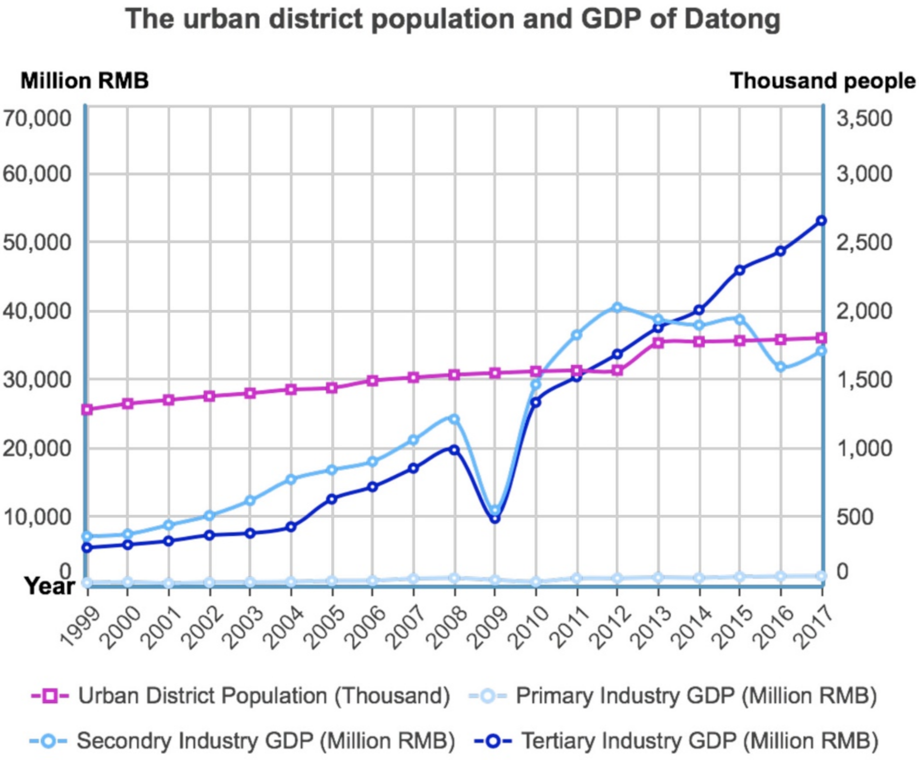


Figure 6.72. The urban district population and gross domestic product (GDP) of Datong. Figure: made by the author based on (Statistical Bureau of Shanxi Province and NBS Survey Office in Shaanxi, 2009~2017).

In figure 6.72, the GDP growth of the tertiary industry in Datong kept rising from 2012 to 2017. Simultaneously, the secondary industry experienced a decrease due to the overcapacity and decline of coal related industries. The urban district population experienced a quick growth in 2012 and then remained stable after 2013, which suggests the tertiary industry might absorb the working population from other industries. The transformation project of Datong ancient city cost about total 60 billion RMB, which contributes to the quick growth of GDP. Accompanied the transformation of ancient city, the government also constructed new urban areas to the east of urban landscape buffer (Figure 6.74). From a comparison of heat map data between the ancient city, the west city and the east new city, the population densities in modern urban areas of the west city is widely scattered. In contrast, the west city and ancient city have a more concentrated population distribution. The Datong university in west city has the highest population density in Datong. However, the population densities of old town, west city and east city differ. In figure 6.73, the east city has the highest population density among the three areas and the population density in west city is higher than that inside the old town. The lowest population density in the ancient city reflects that a large proportion of the population have been transferred to newly-built surrounding communities and the construction inside the ancient city has not been finished. Moreover, the increase of population density in Datong ancient city from weekday to weekend does not match that in Pingyao ancient city, which again confirms that the old town in Datong has not been vitalized yet. More exploration should be done in the future to follow the transformation project of the Datong ancient city.

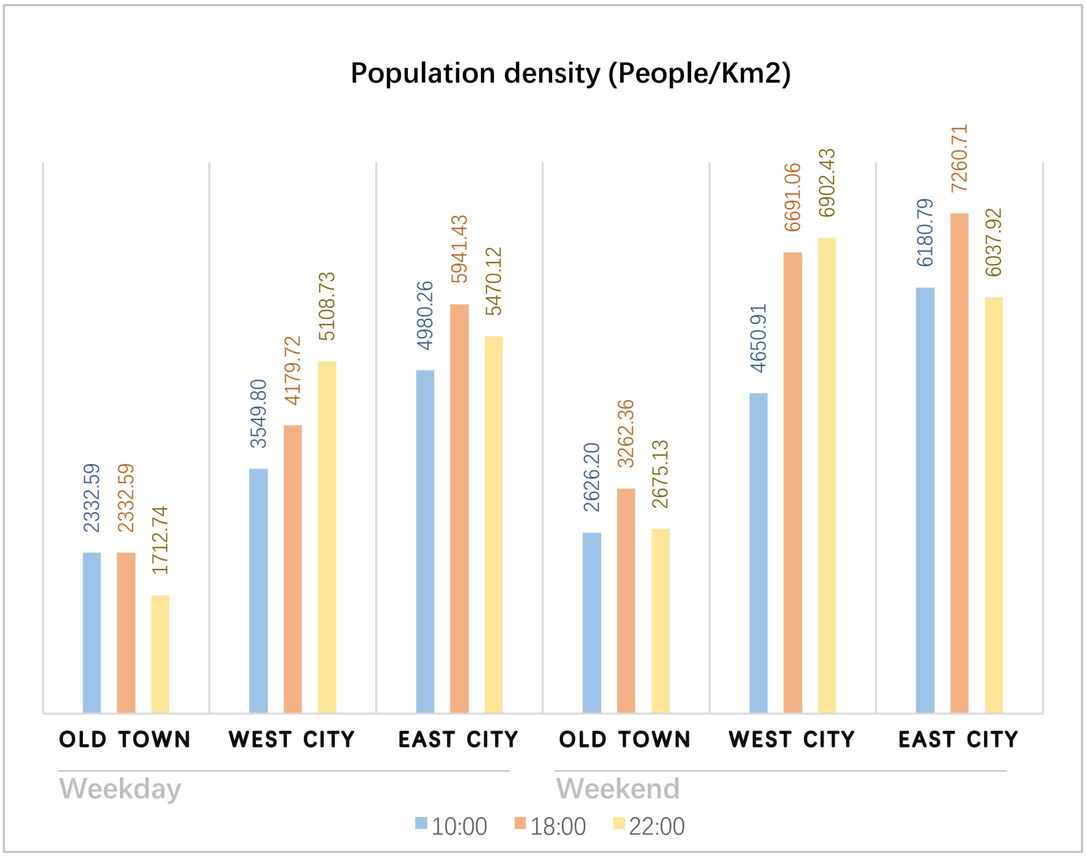


Figure 6.73. The real-time population densities of different areas in the urban district of Datong. Figure drawn by the author.

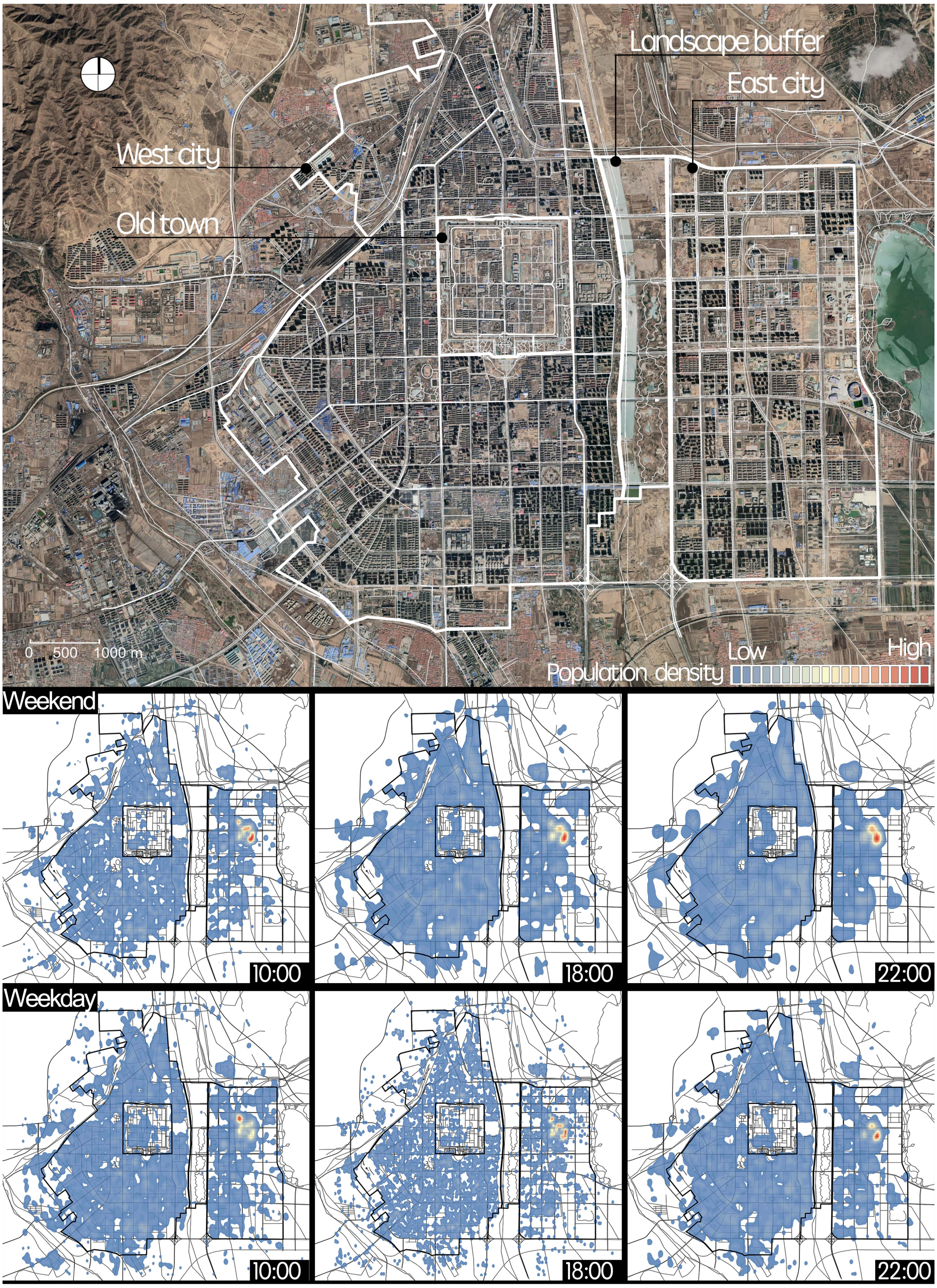


Figure 6.74. The heat map analysis for heritage area (Old town) and urban surroundings of Datong in November 2019. Figure drawn by the author based on maps © Google earth map, Open street map, Tencent map and Baidu map.

Chapter VII

DISCUSSIONS AND CONCLUSIONS

7 Discussions and conclusions

7.1 Discussions

7.1.1 The lineage of CICs and the differences between Chinese typical CICs and other gated urban spaces

In this research, the lineage of CICs in pre-1949 China has been revealed. In contrast to Neolithic remains of double-walled cities, the origin of palace CICs in Xia and Shang dynasties symbolizes the socio-spatial stratification between ruling classes and normal citizens in capital cities. Moreover, the independent governance and collective style of job and life representing the significant features for typical CICs in China have appeared in those ancient palace cities. Additionally, the land use mix combining state governance, royal life and a variety of other services also become matured within the enclosure-gating systems of a palace CIC.

The development and transformation of ancient CICs rely on the agricultural production as well as the climatic requirements, which is limited by the alternation between cold-dry period and warm-wet period. Based on the rich climatic resources, the earliest ancient Chinese empires, Qin and Western Han, developed multi palace CICs within their capital cities. Before and after Qin and Western Han dynasties, the single palace city in a capital city was the prominent feature of city structure, which was influenced by the Jing Tian system and collective life style in agriculture production and consumption. To confront the threat of military invasion and population growth, some capital cities constructed both outer and inner city walls. In particular, the appearance of inner city wall represents the creation of ancient CIC which is not collective and independent in local governance, production and consumption as that in palace CICs and work unit CICs. However, the similarity of rural collective and independent management of production and consumption to the establishment of typical Chinese CICs are revealed in this dissertation, which suggests an influence from rural society in pre-1949 era to the development of urban society after 1949.

In contrast to former studies stressing the general meaning of enclosures and gates in Chinese tradition (Huang, 2006, Xu, 2009a, Yao and Wei, 2012), the differences between Li Fang, court yard house, commercial gated community are distinguished based on different life styles about the scale of collective life, the relationship between job and life as well as the socio-spatial mix inside enclosures, etc. Contrasting to typical CICs, there is no job-housing balance for collective neighbourhoods as well as no large-scale cooperative production and consumption in Li Fang, courtyard houses and present gated commercial communities.

7.1.2 Advanced urban vitality analysis: combining the land use mix and dynamic space use by specific real-time population densities

In urban vitality studies, the land use mix, fine grain, high density and permeability constitute the main factors to stimulate the space use for promoting urban vitality (Rowley, 1996, Sternberg, 2000). In contrast to the geographers and planning experts who mainly focus on the POI data and night lighting data to reveal the urban vitality, I examined the real-time space use with specific locations of a variety of population densities based on the location information of mobile phones. The hourly based data during a whole day, between weekdays and weekends as well as between summer and winter were collected. For revealing how the urban vitality is stimulated as bustling "people places" (Whyte, 1980, Montgomery, 1995, Montgomery, 1998), the spaces with high population densities (The first three highest levels of population density among the total seven levels) was signed as spaces with vitality. With the overlap analysis of locations of various land uses and enlivened spaces, how the urban vitality is produced in and outside CICs can be examined more precisely.

Based on the inference of specific population densities in real time and real places, the comparison of urban vitality in a same place during day and night can also be revealed, avoiding potential errors produced by mingling POI for service (to represent day time urban vitality) and night lighting data (to represent night urban vitality) to reveal a whole day's urban vitality. In particular, for revealing the urban vitality in fine grain (within from $80m^2$ to $1000\ m^2$), if the lighting data can replace the dynamic data of population densities should be examined in the future. Moreover, the POI data for land use mix is a relatively static data. Without the data about locations of space users in specific time, the accuracy of examining the urban vitality stimulated in different times cannot be guaranteed. In particular, even in the same place, the space use vitality changes according to work and leisure times in day and night, weekdays and weekend as well as summer and winter, which has been revealed in the transformed spaces of enterprise CICs.

In the future, if the POI data could include the information of opening time as well as the times of establishment and bankruptcy in each point of institute, the urban vitality studies mainly relying on land use mix of POI data will be closer to the reality of space use. However, in some urban emergency or temporary issues which is irrelevant to the mixed functions represented by the POI data, the vitality analysis relying on the locations of real-time population densities will still has advantage to reveal the reality if the mobile phones are still be the main available communication and payment tools for individuals.

In addition to the traditional urban vitality study methods, the formula of DPMHA and comparison between PRHA and hourly based population densities of each CIC are employed in this research to reveal how work units balance the mixed space uses inside their CICs. For the urban areas with extremely high population densities, though the urban vitality is easy to be detected, the original study perspectives of urban vitality are weak to interpret whether the mixed-use spaces have been fully stimulated. In campus case studies, a large proportion of the DPMHA covers the residence and teaching/researching buildings, which suggests a high job-housing balance. In particular, a higher land use mix promotes the land use balance with a larger capability through distribute the super high population densities into different spaces as much as possible. Moreover, based on the comparison between dynamic changes of high-density areas and population densities, it is found that the public development surrounding the CICs contributes to balancing the space uses inside some CICs during leisure time.

7.1.3 The influence of top-down and bottom-up oriented space use management on land use mix in modern CICs

The land use mix in typical CICs of China has been examined. Ancient palace CICs mainly function as the place of state governance and royal life for ruling classes, which is relatively stable in pre-1949 period with zoning plan for each palace city. Moreover, the land use mix established with (without) zoning plan in modern CICs become one focus in this dissertation. For revealing the differences of land use mix between spaces in campus CICs and enterprise CICs with fine grain, two entropy models have been employed in this dissertation. With the first entropy model, due to the existence of zoning for different functions in every case study, each campus CIC was calculated as one unit for getting the entropy value. With the second entropy model, the highly-mixed functions inside buildings in transformed spaces of an enterprise CIC can be detected within the classified fine grains (every grid with an area of 80 m^2) in each CIC. Based on this method, the difference between top-down oriented and bottom-up oriented space use management in two types of modern CIC spaces can be examined more precisely. The former one contributes to the development of most campuses and transformation of most factory spaces based on zoning plan and the latter one contributes to the transformation of factory spaces in 798.

To examine the land use mix of 15 campus CICs, the specific proportions of spaces with 8 main functions are employed in the entropy calculation, which promotes the accuracy to reflect the reality of mixed-use spaces inside each CIC. However, this is based on the zoning plan in each campus, where each building has one dominant function. In contrast, many of the heritage buildings in 798 always integrate several functions (including exhibitions, shops, restaurants and other institutes) without limits in their proportion in each building. This makes the calculation of land use mix based on detecting the specific area proportion of different spaces hard to be realized. That is also why the fishnet analysis with fine grains based on GIS is better to reveal the land use mix in transformed spaces of enterprise spaces like 798 Art District.

However, the land use mix revealed by the analysis of POI data in specific years only reflects a variety of trends during different times for space use and transformation in enterprise CICs. In this research, the POI data is collected during 2016 and 2018, which cannot reflect the POI change in 2019. In the further urban studies including the CIC phenomenon in China, a more dynamic POI data needs to be developed for a more precise analysis to reflect the change of land use mix.

7.1.4 A low correlation between high permeability and high vitality in modern CICs

This dissertation examines the mixed-use spaces enlivened by high population densities within enclosure-gating systems of modern CICs. In addition, the population densities inside selected modern CIC spaces are higher than that in the surrounding urban environments, which confirms a high space use vitality and low permeability coexist in modern CICs. Moreover, the lower enclosure degree does not significantly correlate with a higher space use balance (DPMHA) that symbolize a higher proportion of spaces inside a CIC has been enlivened. A possible explanation is that the impermeable enclosures protect the inside CIC life from being interrupted by the public and help maintaining a stable land use mix for CIC members.

On the other hand, the analysis of enclosure degree for CIC members and the spatiotemporal integration degree (STID) for public visit confirms the influence of a complex enclosure-gating system in modern CICs to the urban life. Even though it is mainly prohibited for the public visitors to share the CIC spaces, the existence of enclosures also reduced the accessibility of CIC members to outside urban environments. For CIC members, they also have to make compromise between the accessibility and security. In addition, the inside mixed service spaces including canteens, hotels, gymnasiums, hospitals as well as libraries must be employed by scanning digital card, which further prohibits from sharing the land use mix in each campus CIC to the public individuals. However, this also confirms that the population detected in each modern campus CIC is mainly constituted by the CIC members with high density. In contrast to campus CICs, the population in transformed spaces of enterprise CICs is constituted by individuals from different institutes and companies inside and outside the transformed factory spaces. Though the dynamic distribution of high population densities inside enterprise CIC spaces have been revealed in this dissertation, the enclosure systems are still stable to protect three study cases from interruption by outside public. In addition, the turn-outward walls and fragmented boundary spaces maintain the impermeable feature of "walls" surrounding CIC spaces, which exists in both the development and transformation of modern CICs.

7.1.5 The relationship between space use management in CICs and the urban-rural governance

The political control system to maintain the production and consumption keeps a stable development in ancient China, which also indirectly influences the construction and transformation of CICs. Particularly, the influences from agricultural domain to the ancient palace CICs and modern work unit CICs have been examined in this dissertation.

As written by scholars, the collective life style enhanced by Baojia system as one part of the political control system in traditional Chinese society has influences to the work unit management in modern China (Huang, 2006, Lu, 2006). Bray (2005) claims that the bureaucratic system in China contributes to establish an expert dominant local governance style as well as an independent local governance in crisis. In this dissertation, the formation of collective life for social production and consumption in ancient rural areas and its diffusion to modern urban work unit CICs have been demonstrated. In contrast to the studies of the influence of Chinese tradition on a general concept of collective life style, this dissertation examines the specific development and transformation of polices for agriculture production and bureaucratic systems for political control from Western Zhou dynasty to Qing dynasty. This helps to compare the change and continuity of ancient CIC structures with agriculture production as well as political control in urban and rural areas to reveal the differences between CICs in China as well as between collective/independent lives in typical CICs and the rural areas.

This dissertation firstly examines the influences of independent local governance in rural agriculture production and consumption to the establishment of independent state governance and royal life in ancient palace CICs, and then compared them with the establishment of independent local governance in social/industrial production and consumption within modern CICs. In particular, the reasons for independent governance in rural and urban spaces have also been compared, which uncovers the difference and similarity in maintaining the socio-spatial management in ancient rural and modern urban areas of China.

7.2 Conclusion

7.2.1 Verified hypotheses

• The differences between CICs in China

The CICs in China have been classified into typical and atypical ones to compare and distinguish with the CIC concepts in the rest regions of the world. The life styles in atypical CICs, including ancient inner cities as well as old towns within modern urban areas constructed after 1949, have also existed in urban areas from the other parts of the world. This is a reason why these atypical CICs have not been selected as the main focus in this dissertation. However, based on the comparison of typical and atypical CICs in China, the distinguishing features in ancient palace CICs and modern work unit CICs have been revealed.

The land use mix, enclosure-gating system as well as collective life style maintaining job-housing balance constitute the prominent features of a typical Chinese CIC (see Table 7.1). However, in the typical CICs, the palace cities and work units also have clear distinctions to each other. In particular, the modern CICs for work units have a high social mix but the palace CICs are mainly dominated by the ruling classes. Moreover, the duty of state governance in palace CICs has been replaced by the duty of social and industrial production in university and enterprise CICs between 1949 and 1978, which also reflects the diffusion of typical CIC life styles from upper to middle and lower social classes. Contrasting to the palace CICs which have lower population densities than their outside environments, the modern CICs can support a population with much higher densities than the surrounding urban environments.

Comparing typical CICs including palace cities and modern work units, it is demonstrated in this dissertation that the direct municipal management for both ancient inner cities in pre-1949 era and old cities within modern urban areas consolidates the non-collective production and consumption between neighbourhoods. Moreover, the collective relationship mainly confined within the private family domain in above two types of case studies also determines that the land use mix within enclosure-gating systems of typical CICs cannot be employed in large-scale neighbourhood of atypical CICs.

CICs in China Typical Chinese CIC: T Atypical Chinese CIC: A		Ancient CICs	Pre-industrial cities within modern urban areas (A)	Modern CICs of work units (T)		
		Palace CIC (T) Inner CIC (A)		Government agency	Enterprise	University
Building time		Before 1912	Built before 1912 **VS** Rebuilt after 1978	After 1949	Built between 1949 and 1979 **VS** Transformed after 1978	After 1949
Current status	(L)	Removed	Ancient towns in modern urban areas	Existing with development	Removed	Existing with development
	(S)	Transformed into palace museum		Removed	Transformed by emerging industries	Removed
Current spatial impermeability	Enclosure	* * *	* * *	* * *	* * *	* * *
	Gating	* *	*	* * *	*	* *
Socio-spatial mix	Land use mix	Before 1949 * * * Present day *	Before 1949 * * * Present day * *	* * *	* * *	* * *
	Social mix	Before 1949 *(L) * * *(S) Present day * * *	Before 1949 *(L) * * *(S) Present day * * *	* *	* * *	* * *
Job-housing balance		Before 1949 Palace city * * * Inner city * After 1949 *	Before 1949 * After 1949 *	* * *	1949 -1990 * * * After 1990 *	* * *
Collective life		Before 1949 * * *(L) *(S) Present day *	Before 1949 * * *(L) *(S) Present day *	* * *	Before 1990s * * * From 1990s *	* * *
Population density (Compared with surrounding public)		Palace city (Lower) Inner city (Similar)	Lower	Lower/Similar/Higher	Higher	Higher
Social-economic basis		Agriculture & Handcraft industry	Cultural tourism of tertiary industry after 1978	Agriculture & Secondary industry before 1978 Secondary industry & tertiary industry after 1978	Agriculture & Secondary industry before 1978 Secondary industry & Tertiary industry after 1978	Agriculture & Secondary industry before 1978 Secondary industry & tertiary industry after 1978
Climatic requirement		* * * Before 1949 * After 1949	* * * Before 1978 * After 1978	* * Before 1978 * After 1978	* * Before 1978 * After 1978	* * Before 1978 * After 1978
Development / Transformation	Top-down	* * *	* * * After 1978	* * *	After 2005 * * *	* * *
	Bottom-up	None	* * Before 1978	None	2001-2005 * * *	None

Note: * * * **High-degree;** * * **Medium-degree;** * **Low-degree. (L): Large proportion of the number; (S): Small proportion of the number.**

Table 7.1. The classification of Chinese CICs and their differences. Table drawn by the author.

• The establishment of modern CICs influenced by ancient rural collective production-consumption and independent jurisdiction within enclosure-gating systems of palace CICs

The collective tradition of production and consumption is diffused from ancient-rural village in agricultural society to modern-urban CICs in industrial society. However, the different socio-spatial backgrounds of villages and CICs suggest that the multi-levels' system of bureaucracy contributes to the establishment of independent governance of the collectivists in urban areas within enclosures (see Figure 7.2 and 7.3).

In rural areas, the geographical barriers by complicated topography of mountains and rivers between local and central governments (A) as well as between villages (B) fortifies the locally independent management on collective production and consumption within each village (see Figure 7.1). In urban areas, though with a better situation of resource and information exchange, the independent management is also stabilized within the enclosure-gating systems of typical Chinese CICs due to the multi-levels' system of bureaucracy which leads to a self-jurisdiction within enclosures (see Figure 7.2). In contrast to ancient palace CICs for individuals on the top of bureaucratic system, the modern CICs of campuses and enterprises function as basic urban cells with lower level of bureaucracy in political control of normal citizens. However, similar to palace CICs, the independent jurisdiction in work unit CICs formed the division between CIC independent management and the municipal governance, which confirms the enclosure-gating system as a spatial tool for dividing zones under the management from different governance institutes.

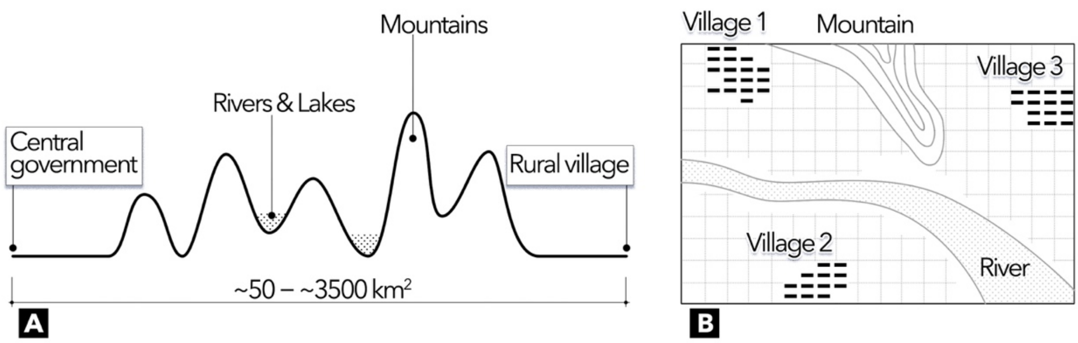


Figure 7.1. the geographical barriers by complicated topography of mountains and rivers between local and central governments (A) as well as between villages (B). Figure drawn by the author.

Figure 7.2 shows the social governance system based on the bureaucracy from central to local governments in rural and urban areas of present day China. In contrast to current villagers' committee which lies at the bottom of rural governance, some work units have higher administrative rank than the Street Office (SO) and Residents' Committee (RC) in bureaucratic system. Take Tsinghua University (THU) for example, there are one SO and nine RCs in the campus of THU and all of them are under the governance of the work unit of THU. Moreover, some officers in the nine RCs are from the retired teachers in the campus, which fortifies the independent governance of the campus CIC. In contrast to THU, the campus CICs of BUAA, USTB and PUHSC locate within the same urban area managed by one SO (Street Office of Huayuan road). However, the work units of three campus CICs, which have a higher bureaucratic level above the SO of Huayuan road, maintain an independent space governance and lead the RCs within them. The members inside each campus CIC enjoyed the public services supported by both the university and the SO because, to some extent, the RC functions as a bond of information transfer and policy implement between the work unit and municipal management.

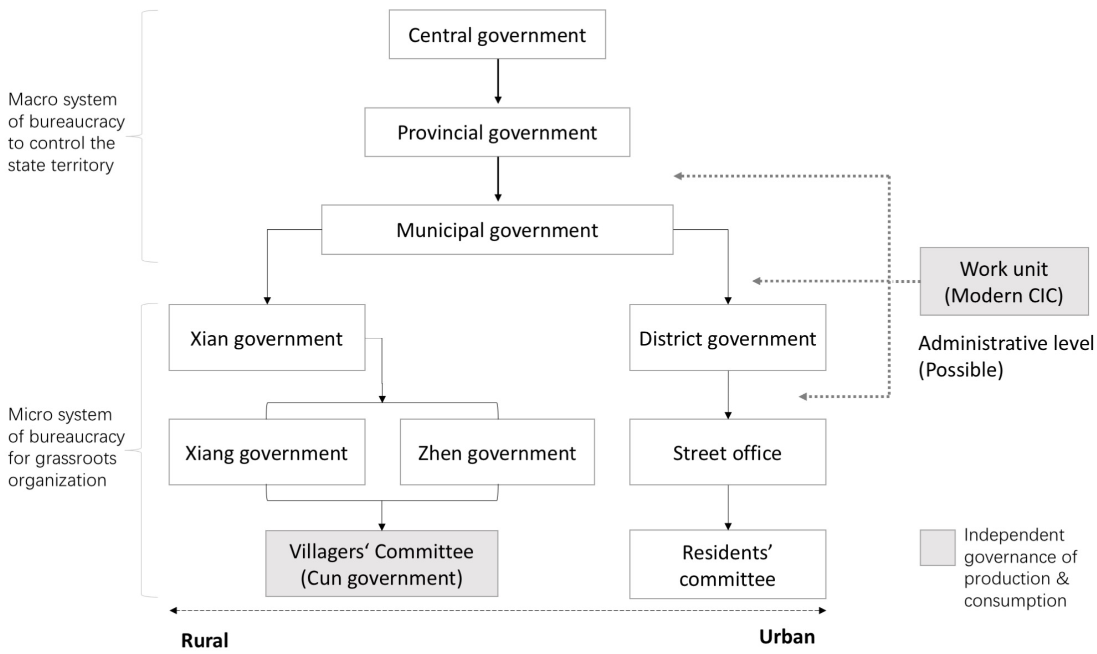


Figure 7.2. The multi-levels' system of bureaucracy in the political control of modern China. Figure drawn by the author.

Figure 7.3 also reflects how the differences in normal urban and rural areas distinguish with the life styles in work unit CICs. Though in rural villages the agricultural production and the local consumption can be supported by the cooperative interaction between villagers, there is no large-scale enclosure-gating system for the families within a village. The managers of each village are selected from the villagers, which suggests that the individuals from families with big influence on the local clan relationship or commune system would have more chances to be selected to lead the local independent governance. In contrast, the independent management in a modern CIC relies more on the bureaucratic appointment depending on the professional management of each work unit. Moreover, a village with hundreds of households could be classified into a large village in rural areas, which cannot match with the large population in a work unit CIC[35]. In addition, the rural collective life style based on the integration of clan tradition and commune system are confronting the challenge of fast urbanization process which attracted large number of peasants from the rural areas.

In contrast to rural villages, the normal urban residence areas in pre-1949 era and present day all construct their own gated communities (including Lv Li and Li fang in pre-1949 era as well as gated residence communities in present day) for normal citizens. However, only the work units integrate the job and housing within the enclosure-gating system of each CIC in modern China. In contrast, the gated communities of commercial residence are mainly managed by the Street Office (SO) and Residents' Committee (RC), which, however, do not have the power to dictate the developers' construction activities. On the other hand, the officers in RC to manage gated commercial communities are appointed by the SO rather than selected from the local residents, which suggests a weaker management and cooperation between RCs and local residents compared to what happens in work unit CICs.

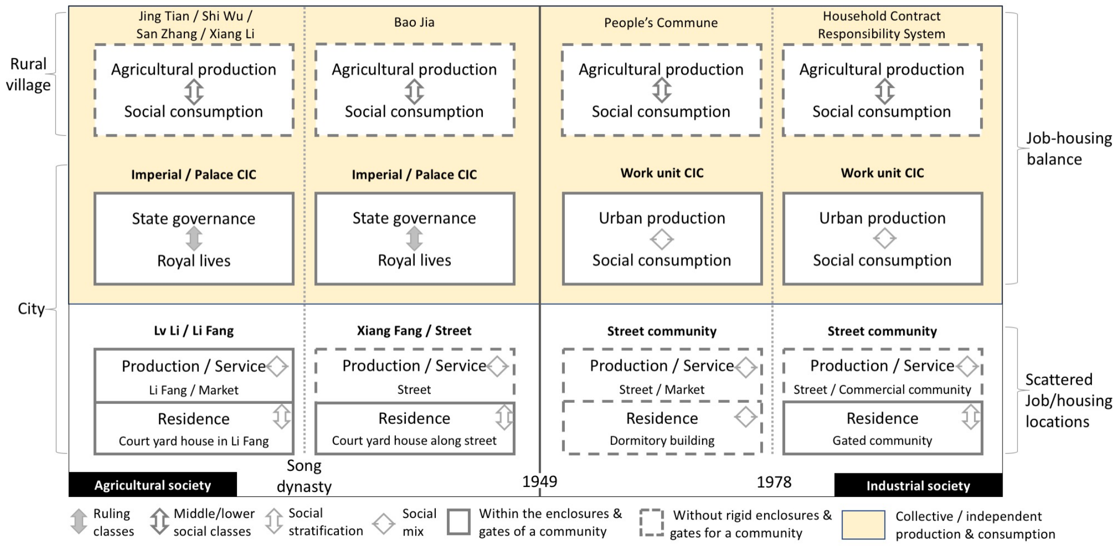


Figure 7.3. The selected typical Chinese CICs as well as the classification of urban-rural life styles for production and consumption in ancient and modern periods. Figure drawn by the author.

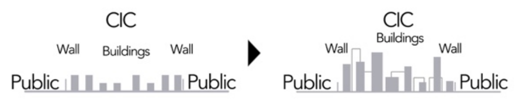
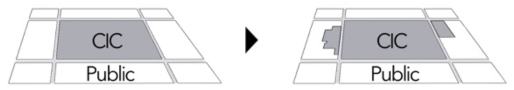
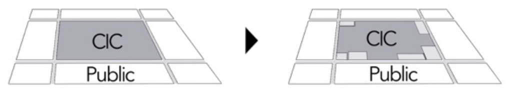
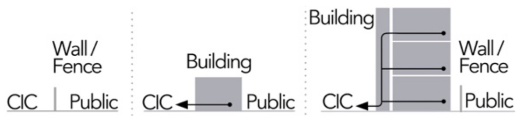
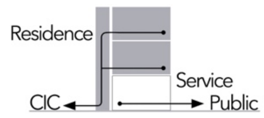
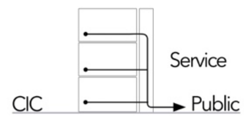
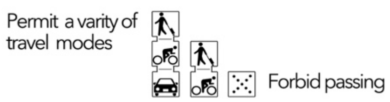
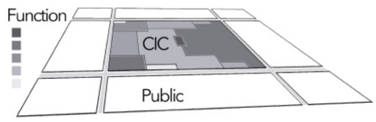
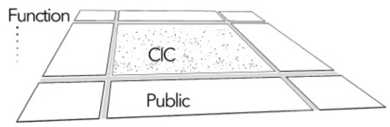
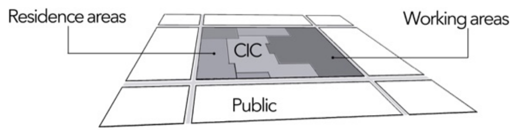
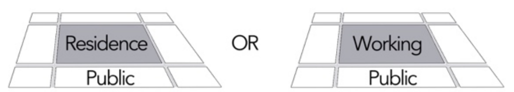
35 For example, THU has about 50,000 people living within its campus and it does not include the extra people who just work in there.

• The development and transformation of modern CICs based on a variety of land use mix and enclosure-gating systems to manage high population densities

To some extent, the development and transformation of CIC spaces suggest the preservation and abandonment of the typical CIC life style in China (see Figure 7.4). The development of university CICs stabilizes the job-housing balance through the expansion of a variety of mixed-use spaces in and surrounding each campus. For example, about 50,000 students and most young teachers of Tsinghua University (THU) live in the same campus in Beijing. Peking University (PKU) expands the campus to the other side of the surrounding urban roads to construct residence buildings, kindergarten as well as research buildings, etc. (see Figure 20A). The above developments contribute to absorbing an increasing population to stimulate the urban vitality within these campus CICs.

In contrast, the managements of living and working areas in every enterprise CIC have been split from each other in the reform towards to a market based economy (see Figure 7.4), which leads to different investments for reusing and transforming the old buildings in residence and factory areas. The factory parts of some enterprise CICs are preserved and transformed into industrial heritage parks for emerging industries, alternatively, they transfer some boundary spaces to developers to absorb funds for the preservation and transformation of heritage buildings.

Contrasting to the transformation of factory areas, some old residence areas in enterprise CICs become dilapidated, which reflects the local governance by Street Office (SO) and Residents' Committee (RC) cannot match the capability of work units in space regeneration or transformation. The space regeneration of the dilapidated residence areas mainly relies on the implement of urban regeneration policies through the multi-levels' bureaucracy system from municipal government to RC (see figure 7.2), which has lower efficiency than the work unit system to meet the local demands. Moreover, without guaranteeing a high return, the commercial developers would not invest in the land transformation of the old residence areas. Hence, due to the lack of benefits from production as well as lying in a low position in the control system of social security and welfare, the SO and RC don't have enough power to dominate the local space transformation and regeneration, which confirms the negative effects of destructing independent and collective CIC life styles. However, in the university CICs' development and enterprise CICs' transformation, the differentiated land use mix and enclosure-gating systems of them (Figure 7.4) still maintain a significant role in managing high population densities. Moreover, the population densities in campus CIC spaces and transformed spaces in enterprise CICs remain higher in working time than surrounding public environments. In particular, the campus CICs maintain a whole day's high density to stimulated its space use vitality in day and night.

Current phenomenon		Illustration	Uni_de	Ent_Tr
Expansion of spaces	**Vertical**: increase FAR through increasing the density of high-rise buildings		**Y** Most	**Y** Laijin **N** 798
	Horizontal: expand the spaces to the other side of the public road outside		**Y** PKU	**N** Most
Fragmentation of boundary spaces (Thick "wall")			**Y** Most	**Y** Most
Enclosure (Impermeable between CIC inner spaces and public)	Walls, fences and buildings (face inward to CIC space)		**Y** Most	**Y** Most
	Residence spaces (face inward to CIC) above ground floor service spaces (turn outward to public)		**Y** Most	**Y** Ba Li Zhuang
	With only service spaces (turn outward to public)		**Y** Most	**Y** Most
Gating system	Difference between CIC members and public individuals	STID degree for public visit: • Open time • Restrictions on vehicles • Zoning management of vehicles Enclosure degree for CIC members: • The area of CIC / The number of gates	**Y** PUHSC **N** BUAA	**Y** Laijin **N** 798 898
	• Open time during day and week	a. Open / Close time during a day • Open time: ~6 am - ~11 pm • Close time: ~11 pm - ~6 am b. Open day in a week: • Forbid visit: week day • Permit visit: weekend	**Y** a. Most b. THU	**Y/N** a. Most b. None
	• The restrictions on different travel modes		**Y** Most	**Y** Laijin **N** 798 898
Land use mix (Entropy of each campus CIC; Entropy of fine grids with 80 m^2 in enterprise CIC)	**Zoning**: top-down oriented		**Y** Most	**Y** Laijin 898
	No zoning: bottom-up oriented		**N** Most	**Y** 798
	Job-housing balance		**Y** Most	**N** Most
	Job-housing imbalance		**N** Most	**Y** Most

Note: **Uni_de**: University CIC's development; **Ent_Tr**: Enterprise CIC's transformation; **Y**: Yes; **N**: No.

Table 7.2. The differences and similarity of university CICs' development and enterprise CICs' transformation in Beijing. Figure drawn by the author.

7.2.2 General learnings

• The justification for considering the influences of local traditional production and consumption system to the construction of modern urban neighbourhoods

Except for the influence of traditional cultural and political control system, the social relationship formed in the traditional economy has a strong influence on the modern society. In particular, the collective management of production and consumption deriving from the farmland in ancient society to establish a cooperative interaction between neighbourhoods contributes to the modern urban expansion for constructing an industrial society. The large urban zoning plan advocated by Soviet experts is only partly realized. Each work unit establishes small zoning areas within its modern CIC to balance the job and housing of CIC members, which reflects a stronger similarity to what appears in the rural villages of ancient China.

The production and consumption can function independently between villages as well as between central and local governments due to the segregation produced by geographical barriers and multi-levels' bureaucracy. In urban areas, the walls and gates function as the spatial division tools to define collective production and consumption activities within each work unit CIC. Moreover, the independent jurisdiction based on the bureaucratic system in each CIC promotes the capability of each work unit to manage the construction of self-contained land uses within their respective enclosures. Lastly, the independent and collective management system of production and consumption to protect against the social risks due to the lack of support by central government in public service and finance has diffused from ancient agriculture society to modern industrial society of China. Therefore, in the study of modern urban neighbourhoods, the social inertia of the local tradition in production and consumption and its influence to modern socio-spatial interaction should be integrated into consideration, which, to some extent, can further influence the establishment of urban morphology.

However, in current market based economy, accompanying the rise of private companies and the fall of enterprise work units, the increasingly stronger central government starts to take more responsibilities in providing public service and funding, which in turn weakens the role of work unit CICs in preserving a collective and independent urban life style. Accompanying the appearance of matured public service in the surrounding urban environments of a modern CIC, those work units may have more intension to get rid of the responsibility of maintaining a complexly collective life style and to focus on their main production activities. This potential trend also deserves our attention in future study.

• The necessity to adjust the planning theories and study methods of urban vitality to locally based situations

The study of selected modern CICs in this dissertation reflects that the permeability is not a prerequisite to promote the urban vitality, which suggest that the planning theories of urban vitality should be adjusted to analysing the distinctions of locally based urban environments. In addition, the space use with high vitality inside enclosures and gates of modern CICs also suggests that the different permeability of space use for individuals in and outside CICs offer a new angle to comprehend the role of low permeability in maintain the urban vitality. In the future, it is necessary to detect the roles of land use mix, permeability, high density and fine grain, etc. in stimulating urban vitality based on the specific local situations.

Moreover, to reveal the reality of urban vitality in specific case studies, more precise data about the dynamic land use should be collected and analysed. In particular, the space use by specific population densities in hourly-based real-times should be considered in the study to reflect the change of space use vitality in different places of each case study. Based on above analysis method, the behaviour of people in mixed use spaces could be uncovered, which will further promote the interpretation of urban vitality studies.

• The possibility to enliven the dilapidated CIC spaces through integrating emerging industries under work unit management

Though the residence areas have been detached from the management of enterprise CIC spaces, the experience of constructing the land use mix is still preserved in the work unit management system. It transformed the mixed-use spaces based on self-managed production in planned economy to that based on the rents from and land transfer to emerging industries in market economy.

As the place-identity generators fixing the meanings of place (Harvey, 1989), the heritage buildings in those industrial factories integrate the industrial transition into the reuse of old factories, creating new enlivened communities. However, some work units still maintained a top-down oriented management to determine what types of emerging industries and how they can be integrated into the preserved factory spaces. In 798, even the bottom-up oriented transformation based on the contributions by artists, designers and other institutes is, to some extent, realized under the management and support from the managers of the original work unit. In contrast, the new space transformation in Laijin is only permitted within the buildings and the exterior of buildings as well as landscapes are forbidden to change by the work unit managers. The current high population densities of space users as well as the space use vitality in Laijin and 798 indicate a possible tactic for space transformation in declined enterprise CICs, even though it cannot prevent the "gone" of collectivist life style in modern CICs. However, in contrast to the homogenized urban construction based on large-scale land transfer and commercialization of enterprise CIC spaces, what is carried on in modern CIC spaces like 798 and Laijin integrates the preservation of urban memories and the development of emerging industries, which contributes to establish a more diversified urban environment.

On the other hand, due to the lack of self-managed industrial production and residence by the transformed enterprise, it becomes a challenge to distinguish between the current economic roles of work units like Laijin and that of the other private commercial developers. To some extent, all above institutes become the assimilation products in the market based commercial competition. Without the state policy support to preserve the industrial heritage buildings, it is also hard to imagine the work units relying on the rents from low FAR spaces in their CICs to survive in the market, which should be taken into the consideration as a more macro top-down oriented influence in present day study of the transformation of modern CICs.

7.2.3 Outlook

About the CIC life style integrating job and housing within enclosures, the campus and enterprise CICs all encounter respective challenges due to the scarce of residence space. In the transformation of spaces in enterprise CICs, due to the separation between the working and living functions, the individuals in office and residence areas all suffer from the long commutes in present day. Comparing to the transformation of enterprise CICs, the teachers living and working in campus CICs also face new difficulties. For example, the staff and their family members who lived inside campus CICs possess the apartment property even if they retired, which should be protected by law. On the other hand, the limited land resource within each CIC cannot meet the demand of campus residence for increasing number of university staff. Even though many universities build new staff dormitory buildings outside the campus, the pursuit of job-housing balance is challenged by the long-distance commute and traffic congestion. In the future, if the universities can develop better situations for residence with mixed services in new communities outside campuses for retired colleagues, the apartments inside campuses can be exchanged based on the principle of voluntariness. Then the emptied apartments within campuses can be redistributed to new colleagues with low rent. Hence, the realization of the principle of voluntary exchange relays on the capability of each university to fund the land acquisition and establishment of new mixed-use spaces for canteen, health care and entertainment, etc. in staff residence communities outside campuses for retired colleagues. It is also dependent on the support and cooperation from the municipal governance.

The self-managed production inside modern CICs is a fundamental source of power to support the job-housing balance for CIC members. In the market based reform after 1978, the enterprise work units in secondary industry declined, which led to the destruction of CIC life styles and space transformation of enterprise CICs. In contrast, the emerging industries absorbed the increasing graduated students from universities, which in turn stimulated the boom of tertiary industry. In this process, the universities met a historical opportunity for development, which fortified and enriched the land use mix and enclosure-gating systems of each campus CIC. To some extent, without the self-managed production to establish a solid economic basis and form a close social relationship between colleagues, the independent governance of job, housing and related public services to resolve the hold-up problem mentioned by Deng (2018) cannot be realized. On the other hand, the industrial policies play a significant role in supporting the rising of private emerging industries in the economic transformation from planned economy to a market based economy, which also promotes the higher education industry through establishing a thriving and upgraded job market. The aforementioned statements offer a pragmatic perspective based on production management and industrial policies to investigate and evaluate whether the form of work unit CIC could be widely revived in the future urban society.

The social mix formed in the development and transformation of modern CICs also deserves a further exploration in the future. The campus CICs develop a social mix between acquaintances including teacher and students from different social classes in urban and rural areas. However, with the social development, whether the social mix within the selected CICs has changed and how it influences the CIC life style have not been revealed in this dissertation. On the other hand, in the transformed enterprise CIC spaces, a new social mix constituted by individuals from different companies and institutes has replaced the original social mix constituted by the colleagues of a same work unit. In the future study, how to reveal the socio-spatial interaction based on detailed statistics of the dynamic social mix in different modern CICs would be a potential perspective to examine the modern CIC life styles.

Last but not the least, the modern CICs integrated Residents' Committee (RC) management lying at the bottom bureaucratic system and the independent work unit management, which distinguishes the single RC management of the gated residence communities. However, the latter one has become the main urban management tactic for gated communities that are dominant in current residence market, which leads to the spatial detachment between household and work place. To some extent, it is the long distance between homes and offices that exacerbates the urban congestion and reduces the efficiency of working and living for the large population in the metropolis like Beijing. On the other hand, the large number of small and medium-sized enterprises (SMEs) rising in the market based economy also lack the capability to combine the job and housing for their staff to reduce the commuting time as what has been done in work unit CICs. How the governments, enterprises and individuals can cooperate to create a new resolution to handle above issues in the future deserves a further investigation.

Appendix

Other relevant tables

Table 1A. Some significant words and their translation between Chinese and English in this dissertation.

English translation	Pinyin	Chinese
Urban planning and social mangement in ancient urban planning		
Palace city	Gongcheng	宫城
Imperial city	Huangcheng	皇城
Inner city	Neicheng	内城
Outer city	Kuocheng	廓城
King City Map of Zhou	Zhou Wangcheng Tu	周王城图
Lv Li	Lvli	闾里
Li Fang	Lifang	里坊
Xiang Fang	Xiangfang	厢坊
Hu Tong	Hutong	胡同
Court yard housing	Siheyuan	四合院
Feng Shui	Fengshui	风水
Patriarchal clan system	Zongfa Zhidu	宗法制度
Feoff system	Fenfeng Zhidu	分封制度
System of prefectures and counties	Junxian Zhidu	郡县制度
Jun Guo system	Junguo Bingxing Zhidu	郡国制度
The names of historical regions, states, dynasties and capita cities		
Longshan culture	Longshan Wenhua	龙山文化
Three dynasties	Sandai	三代
Xia dynasty	Xiachao	夏朝
Shang dynasty	Shangchao	商朝
Zhou dynasty	Zhouchao	周朝
Western Zhou	Xizhou	西周

Eastern Zhou	Dongzhou	东周
Spring and Autumn period	Chunqiu	春秋
Warring States	Sanguo	三国
Warring States period	Zhanguo	战国
State Wei	Weiguo	魏国
State Lu	Luguo	鲁国
State Qi	Qiguo	齐国
State Han	Hanguo	韩国
State Zhao	Zhaoguo	赵国
Feng’ jing	Fengjing	丰京
Hao’ jing	Haojing	镐京
Luo’ yi	Luoyi	洛邑
State Qin	Qinguo	秦国
Qin dynasty	Qinchao	秦朝
Xian'yang	Xianyang	咸阳
Han dynasty	Hanchao	汉朝
Chang'an	Changan	长安
Luo'yang	Luoyang	洛阳
Western Han	Xihan	西汉
Eastern Han	Donghan	东汉
Three Kingdoms	Sanguo	三国
Cao Wei	Caowei	曹魏
Ye'cheng	Yecheng	邺城
Eastern Wu	Dongwu	东吴
Shu Han	Shuhan	蜀汉
Guanzhong plain	Guanzhong Pingyuan	关中平原
Guandong plain	Guandong Pingyuan	关东平原
The words about modern urban planning		
Work unit	Danwei	单位
Job-housing balance	Zhizhu Pingheng	职住平衡
Space use balance	Kongjian Shiyong Pingheng	空间使用平衡

Urban vitality	Chengshi Huoli	城市活力
Urban heat map	Chengshi Reli Ditu	城市热力地图
Urban industrialization	Chengshi Gongyehua	城市工业化
Points of interest	Xingqu Dian	兴趣点
Planned economy	Jihua Jingji	计划经济
Market economy	Shichang Jingji	市场经济
Enterprise reform	Qiye Gaizhi	企业改制
Land use mix	Tudi Liyong Hunhe	土地利用混合
Gated community	Menjin Xiaoqu	门禁小区
Industrial land	Gongye Yongdi	工业用地
Commercial land	Shangye Yongdi	商业用地
Land transaction	Tudi Zhuanrang	土地交易
Land transfer	Tudi Zhuanrang	土地转让
Land commercialization	Tudi Shangyehua	土地商业化
Land finance	Tudi Caizheng	土地财政
Municipal Management	Shizheng Guanli	市政管理
State enterprise	Guoyou Qiye	国有企业
Collectively-owned enterprise	Jiti Qiye	集体企业
Privately-owned enterprise	Siying Qiye	私营企业
Beijing No.2 Textile Factory	Jingmian Erchang	京棉二厂
Laijin Culture Creative Industrial Park	Laijin Wenhua Chuangyi Chanyeyuan	莱锦文化创意产业园
798 Art District	798 Yishuqu	798 艺术区
898 Innospace	898 Chuangxin Kongjian	898 创新空间

Table 2A. The list of enterprises that had decided to rent in Laijin Culture Creative Industrial Park before 2013. Data source © Laijin Culture Creative industrial Park.

Enterprise name of tenants	**Lease area (m^2)**	**Industrial sector**	**Total area (m^2)**	**Rate**
Beijing Rongbang Education development	3488	Culture, Education	37769.5	51%
Beijing Rongbang Design	3297	Culture & Art, Design Service		
Lanhai media	4261	Media		
Beijing Qingqing	2,951	New media, TV, Cinema、		
Beijing Senhe Jiamao	618	Culture & Art, Design Service		
Beijing Dongfang Chuanchang	474	Advertisement		
Beijing Zhongchuan Shixun	2664	Software， Internet ， Computer Service		
Beijing Baiyu	562	Financial investment		
Beijing Ruyixinxin	2899	New media, TV, Cinema、investment		
Chengtianyou（Beijing）	4261	Information technology		
Zhongtie Huafeng（Beijing）	2233	Real Estate investment		
Xinsilu（Beijing）	1101	Culture media		
Tianjin Daohong	2885	Financial investment		
Dongya Fengli	973	New media, Press, TV, Cinema		
Beijing Derun Jiecheng	892	Culture & Art, Design Service		
Dasheng Guoji	580	New media, Press, TV, Cinema、		

		advertisement, Exhibition
Xinshi Kongjian（Beijing）	562	Culture & Art, Design Service
Shangying Huanya （Shanghai）	390	New media, Press, TV, Cinema、
Beijing Jiudao	390	Culture & Art, culture communication
Beijing Quanming	315	New media, Press, TV, Cinema, advertisement, Exhibition
Beijing Zhonghui	390	Sports management
Beijing Wangkaifang	594	Culture & Art, Design Service
Beijing Guanglingyu	330	New media, Press, TV, Cinema、 advertisement, Exhibition
Beijing Guanzhu	330	Culture & Art, Design Service
Beijing Tianshirui	330	Culture & Art, Design Service

Table 3A. The statistics of the enrolment exam of high education in China from 1978. Data source © (China, 1998-2018, Xiong, 1983, National Bureau of Statistics, 1981-2017)

Time (year)	The number of students attending the enrolment exam (Thousand)	The admitted number of students (Thousand)	Enrolment rate (%)
1977	5700	270	0.047368421
1978	6100	402	0.065901639
1979	4680	280	0.05982906
1980	3330	280	0.084084084
1981	2590	280	0.108108108
1982	1870	320	0.171122995
1983	1670	390	0.233532934
1984	1640	480	0.292682927
1985	1760	620	0.352272727
1986	1910	570	0.298429319
1987	2280	620	0.271929825
1988	2720	670	0.246323529
1989	2660	600	0.22556391
1990	2830	610	0.215547703
1991	2960	620	0.209459459
1992	3030	750	0.247524752
1993	2860	920	0.321678322
1994	2510	900	0.358565737
1995	2530	930	0.367588933
1996	2410	970	0.402489627
1997	2780	1000	0.35971223
1998	3200	1080	0.3375
1999	2880	1600	0.555555556
2000	3750	2210	0.589333333

2001	4540	2680	0.59030837
2002	5100	3200	0.62745098
2003	6130	3820	0.623164763
2004	7290	4470	0.613168724
2005	8770	5040	0.574686431
2006	9500	5460	0.574736842
2007	10100	5660	0.56039604
2008	10500	5990	0.57047619
2009	10200	6290	0.616666667
2010	9570	6570	0.686520376
2011	9330	6750	0.723472669
2012	9150	6850	0.74863388
2013	9120	6840	0.75
2014	9390	6970	0.74227902
2015	9420	7000	0.743099788

Table 4A. The Chinese universities in 985 project, 211 project and double-class project. (•: yes; A: a level; B: b level.).

City and top universities in it	985 project	211 project	Double-class project
Beijing	8	26	8
Tsinghua University (THU)	•	•	A
Peking University (PKU)	•	•	A
Beijing Normal University (BNU)	•	•	A
Renmin University of China (RUC)	•	•	A
Beijing Jiaotong University (BJTU)		•	
Beijing Institute of Technology (BIT)	•	•	A
Beijing University of Aeronautics and Astronautics (BUAA)	•	•	A
Beijing University of Technology (BJTU)		•	
University of Science and Technology Beijing (USTB)		•	
Beijing University of Chemical Technology (BUCT)		•	
University of International Business and Economics (UIBE)		•	
Beijing Forestry University Beijing (BJFU)		•	
Communication University of China (CUC)		•	
Minzu University of China (MUC)	•	•	A
Beijing Sport University (BSU)		•	
Central Conservatory of Music (CCOM)		•	
Central University of Finance and Economics (CUFE)		•	
China University of Political Science and Law (CPUL)		•	
Beijing University of Posts and Telecommunications (BUPT)		•	
North China Electric Power University (NCEPU)		•	
Beijing University of Chinese Medicine (BUCM)		•	
Beijing Foreign Studies University (BFSU)		•	
China Agricultural University (CAU)	•	•	A
China University of Geosciences, Beijing (CUGB)		•	
China University of Mining and Technology, Beijing (CUMTB)		•	

China University of Petroleum, Beijing (CUPB)		•	
Shanghai	4	9	4
Fudan University (FU)	•	•	A
Shanghai International Studies University (SHISU)		•	
East China Normal University (ECNU)	•	•	A
Shanghai University (SHU)		•	
Shanghai University of Finance and Economics (SUFE)		•	
East China University of Science and Technology (ECUST)		•	
Tongji University (TJU)	•	•	A
Shanghai Jiao Tong University (SJTU)	•	•	A
Donghua University (DHU)			
Nanjing	2	8	2
Nanjing University (NJU)	•	•	A
Southeast University (SEU)	•	•	A
Nanjing Normal University (NNU)		•	
China Pharmaceutical University (CPU)		•	
Nanjing Agricultural University (NAU)		•	
Nanjing University of Science and Technology (NUST)		•	
Hohai University (HHU)		•	
Nanjing University of Aeronautics and Astronautics (NUAA)		•	
Wuhan	2	7	3
Wuhan University (WHU)	•	•	A
Huazhong University of Science and Technology (HUST)	•	•	A
China University of Geosciences, Wuhan (CUGW)		•	
Wuhan University of Technology (WUT)		•	
Central China Normal University (CCNU)		•	A
Huazhong Agricultural University (HAU)		•	
Zhongnan University of Economics and Law (ZUEL)		•	
Xiaan	2	6	2
Xiaan Jiaotong University (XJTU)	•	•	A
Northwestern Polytechnical University (NPU)	•	•	A
Northwestern University (NU)		•	

Chang'an University (CAU)		•	
Shaanxi Normal University (SNNU)		•	
Xidian University (XDU)		•	
Chengdu	2	5	2
Sichuan University (SCU)	•	•	A
Southwestern University of Finance and Economics (SWUFE)		•	
University of Electronic Science and Technology (UEST)	•	•	A
Southwest Jiao Tong University (SWJTU)		•	
Sichuan Agricultural University (SAU)		•	
Guangzhou	2	4	2
Sun Yat-sen University (SYSU)	•	•	A
Jinan University (JNU)		•	
South China University of Technology (SCUT)	•	•	A
South China Normal University (SCNU)		•	
Harbin	1	4	1
Harbin Institute of Technology (HIT)	•	•	A
Harbin Engineering University (HEU)		•	
Northeast Agricultural University (NEAU)		•	
Northeast Forestry University (NEFU)		•	
Changsha	3	4	3
Hunan University (HNU)	•	•	B
Central South Normal University (CSNU)		•	
Central South University (CSU)	•	•	A
National University of Defence Technology (NUDT)	•	•	A
Tianjin	2	3	2
Tianjin University (TJU)	•	•	A
Nankai University (NKU)	•	•	A
Tianjin Medical University (TJMU)		•	
Hebei University of Technology (HUT)		•	
Hefei	1	3	1
University of Science and Technology of China (USTC)	•	•	A
Anhui University (AHU)		•	

Hefei University of Technology (HFUT)		•	
Chongqing	1	2	1
Chongqing University (CQU)	•	•	A
Southwest University (SWU)		•	
Dalian	1	2	1
Dalian University of Technology (DUT)	•	•	A
Dalian Maritime University (DLMU)		•	
Shenyang	1	2	1
Northeastern University (NEU)	•	•	B
Liaoning University (LNU)		•	
Changchun	1	1	1
Jilin University	•	•	A
Xianyang	1	1	
Northwest A&F University (NWAFU)	•	•	B
Suzhou	0	1	0
Soochow University (SU)		•	
Wuxi	0	1	0
Jiang Nan University (JNU)		•	
Xuzhou	0	1	0
China University of Mining and Technology, Xuzhou (CUMTX)		•	
Jinan	1	1	1
Shandong University (SDU)	•	•	A
Qingdao	1	1	1
Ocean University of China (OUC)	•	•	A
Dongying			
China University of Petroleum, Dongying (CUPD)		•	
Hangzhou	1	1	1
Zhejiang University (ZJU)	•	•	A
Xiamen	1	1	1
Xiamen University	•	•	A
Fuzhou	0	1	0
Fuzhou University		•	

Haikou	0	1	0
Hainan University (HNU)		•	
Nanning	0	1	0
Guangxi University (GXU)		•	
Kunming	0	1	1
Yunnan University (YNU)		•	B
Guiyang	0	1	0
Guizhou University (GZU)		•	
Xining	0	1	0
Qinghai University (QHU)		•	
Lhasa	0	1	0
Tibet University (TU)		•	
Urumchi	0	1	1
Xinjiang University (XJU)		•	B
Shihezi	0	1	0
Shihezi University (SHZU)		•	
Lanzhou	1	1	1
Lanzhou University (LZU)	•	•	A
Yinchuan	0	1	0
Ningxia University (NXU)		•	
Hohhot	0	1	0
Inner Mongolia University (IMU)		•	
Taiyuan	0	1	0
Taiyuan University of Technology (TYUT)		•	
Zhengzhou	0	1	1
Zhengzhou University (ZZU)		•	B
Nanchang	0	1	0
Nanchang University (NCU)		•	

Table 5A, The statistics of employment number (unit: thousand) in National urban units of China. (按城乡分就业人员数 (年底数) – 全国城镇单位). Data source © (National Bureau of Statistics, 1981-2017)

Year	Total urban units	State-owned units	Collectively-owned units	Proportion of public-owned units
1978	95140	74510	20480	0.998423376
1980	105250	80190	24250	0.992304038
1985	128080	89900	33240	0.961430356
1990	170410	103460	35490	0.815386421
1991	174650	106640	36280	0.818322359
1992	178610	108890	36210	0.812384525
1993	182620	109200	33930	0.783758624
1994	186530	112140	32850	0.777301238
1995	190400	112610	31470	0.756722689
1996	199220	112440	30160	0.715791587
1997	207810	110440	28830	0.670179491
1998	216160	90580	19630	0.509853812
1999	224120	85720	17120	0.458861324
2000	231510	81020	14990	0.414712107
2001	241230	76400	12910	0.370227584
2002	251590	71630	11220	0.329305616
2003	262300	68760	10000	0.30026687
2004	272930	67100	8970	0.278716154
2005	283890	64880	8100	0.257071401
2006	296300	64300	7640	0.242794465
2007	309530	64240	7180	0.230736924
2008	321030	64470	6620	0.221443479
2009	333220	64200	6180	0.211211812
2010	346870	65160	5970	0.205062415
2011	359140	67040	6030	0.203458261
2012	370120	68390	5890	0.200691668
2013	382400	63650	5660	0.18125

2014	393100	63120	5370	0.174230476
2015	404100	62080	4810	0.165528335

Table 6A, The statistics of the industrial enterprises from 1978 to 2007: number of the industrial enterprises and their proportion. Data source © Number of Industrial Enterprises and Gross Industrial Output Value (1949-2008 年全国工业企业单位数和工业总产值汇总表) in (National Bureau of Statistics, 1981-2017)

Year	Number of Industrial Enterprises (1000 units)	State-owned enterprises	Collectively-owned enterprises	Proportion of public ownership enterprises
1977	322.7	82.1	240.6	1
1978	348.4	83.7	264.7	1
1979	355	83.8	271.2	1
1980	377.3	83.4	293.5	0.998939836
1981	381.5	84.2	296.8	0.998689384
1982	388.6	86	301.9	0.998198662
1983	392.5	87.1	304.6	0.997961783
1984	437.2	84.1	352.1	0.997712717
1985	463.2	93.7	367.8	0.996329879
1986	499.3	96.8	400.4	0.995794112
1987	493.6	97.6	392.1	0.992098865
1988	500	99.1	395.4	0.989
1989	505.4	102.3	395.9	0.985753858
1990	504.4	104.4	391.1	0.982355274
1991	504.8	104.8	389.2	0.978605388
1992	502.1	103.3	384.5	0.971519618
1993	520.1	104.7	383.3	0.9382811
1994	531.8	102.2	385.1	0.916321926
1995	592.1	118	413.6	0.897821314
1996	578.8	113.8	394.8	0.878714582
1997	534.4	98.6	357.9	0.854229042
1998	165.1	64.7	47.7	0.680799515
1999	162	50.7	42.6	0.575925926
2000	162.9	53.5	37.8	0.560466544

2001	171.3	46.8	31	0.454173964
2002	181.6	41.1	27.5	0.377753304
2003	196.2	34.3	22.5	0.28950051
2004	219.5	31.8	21.1	0.241002278
2005	271.8	27.5	15.9	0.159676233
2006	302	25	14.2	0.129801325
2007	336.8	20.7	13	0.100059382
2008	426.1	21.3	11.7	0.077446609

Table 7A. Statistics of urban higher-educational institutes (Beijing). Source © 20-1 Basic statistics of education (1978-2017) (北京基本教育情况统计: 1978-2017 年).

	Number of high education institutes	**Students in universities**	**Enrolment number**	**Graduated number**
1978	35	48.618	17.445	10.881
1979	48	55.073	15.848	8.585
1980	50	83.032	17.972	8.233
1981	51	98.044	17.921	2.289
1982	51	93.878	21.936	25.753
1983	54	90.894	27.988	31.009
1984	57	102.962	31.805	20.11
1985	61	122.791	40.67	21.442
1986	66	129.647	35.39	26.953
1987	67	136.694	41.163	34.894
1988	67	145.134	42.187	33.066
1989	67	141.625	33.557	35.863
1990	67	139.646	36.275	36.171
1991	67	136.94	37.7	37.702
1992	67	139.978	41.517	37.075
1993	66	158.906	52.205	32.888
1994	67	175.203	51.884	34.855
1995	65	182.173	52.868	45.094
1996	65	189.953	55.269	46.471
1997	65	195.842	56.884	49.973
1998	63	212.984	62.264	49.322
1999	64	234.033	78.354	49.936
2000	59	282.585	99.397	51.556
2001	61	340.284	116.344	55.831
2002	62	398.573	128.32	67.621
2003	74	458.898	143.483	83.816

2004	77	500.245	147.298	99.637
2005	79	536.724	156.124	117.367
2006	82	554.702	154.969	132.488
2007	83	567.875	156.222	138.834
2008	82	575.639	157.238	149.459
2009	88	577.154	158.992	152.336
2010	89	577.828	155.228	150.156
2011	89	578.633	157.543	151.277
2012	91	581.844	162.042	152.98
2013	89	589.234	163.081	148.689
2014	89	594.614	160.056	147.023
2015	90	593.448	152.741	152.118
2016	91	588.389	154.715	153.005
2017	92	580.663	153.028	152.99

Table 8A. The number (unit: thousand) of employees at the end of each year in urban units and the total amount of wages (unit: billion RMB). Data source: © Beijing Municipal Bureau of Statistics，BMBS & NBS Survey in Beijing (2018) (北京城镇单位在岗职工年末人数及工资总额: 1978-2017 年).

Year	Total population	State owned unit population	Collective unit population	Other population	Sum of the wages	State owned unit wages	Collective unit wages	Other wages
1978	2916	2409	507	0	1.87	16.2	2.5	0
1979	3119	2542	577	0	2.24	19.4	3	0
1980	3265	2694	571	0	2.69	23.3	3.6	0
1981	3444	2831	613	0	2.83	24.2	4.1	0
1982	3601	2930	671	0	3.05	25.9	4.6	0
1983	3719	3034	685	0	3.38	28.5	5.3	0
1984	3754	3025	716	13	4.04	33.7	6.6	0.1
1985	3823	3081	726	16	5.07	41.5	9	0.3
1986	3979	3244	711	24	5.8	48.5	9.1	0.4
1987	4052	3318	707	27	6.67	56	10.1	0.6
1988	4104	3364	699	41	8.12	68.1	12.1	1
1989	4184	3438	674	72	9.63	81	13.4	1.9
1990	4549	3579	868	102	11.89	96.1	19.7	3.1
1991	4700	3678	890	132	13.22	106.1	21.5	4.6
1992	4766	3715	905	146	15.85	128.6	23.9	6
1993	4673	3623	796	254	21.89	176.6	28.5	13.8
1994	4718	3635	734	349	30.65	243.4	36.2	26.9
1995	4709	3582	721	406	38.2	295.6	46.5	39.9
1996	4606	3490	648	468	44.24	339.4	46.2	56.8
1997	4653	3487	650	516	51.48	383.6	53.8	77.4
1998	4501	3217	508	776	55.82	391.9	45	121.3
1999	4380	3030	496	854	61.45	420	44.8	149.7
2000	4342	2830	460	1052	69.55	453.6	46.7	195.2
2001	4003	2359	400	1244	77.73	477.8	44.8	254.7

2002	4342	2126	327	1889	95.09	508.8	40	402.1
2003	4363	1976	261	2126	109.89	565.5	35	498.4
2004	4464	1837	248	2379	131.51	625.7	34	655.4
2005	4484	1785	207	2492	152.01	694.9	30.8	794.4
2006	4531	1729	164	2638	180.55	738	30.5	1037
2007	4789	1727	154	2908	219.43	862.4	31.2	1300.7
2008	5261	1710	227	3324	287.43	1008.8	48.2	1817.3
2009	5604	1709	224	3671	322.72	1074.3	53.3	2099.6
2010	5877	1751	211	3915	378.91	1221.2	56.7	2511.2
2011	6403	1771	187	4445	477.86	1421.1	62.3	3295.2
2012	6704	1773	186	4745	565.79	1582.5	71.6	4003.8
2013	6955	1784	165	5006	650.2	1724.7	70.2	4707.1
2014	7088	1777	178	5133	729.33	1884.5	81.5	5327.3
2015	7248	1728	160	5360	822.52	2059	81.5	6084.7
2016	7335	1780	131	5424	900.5	2299	80.1	6625.9
2017	7564	1743	135	5686	1018.28	2611	80.9	7490.9

Notice：

1. Here, in 2007 and before, the urban work units exclude township enterprises, private companies and privately-owned small business. In 2008 and beyond, urban units refer to work units that do not include private units and individual industrial and commercial households.

2. In the table, the data of 2000 and before are employees, including employees on duty and those not on duty

Table 9A. The menu of the restaurant in the residence area of an enterprise named (精棉二厂). The manufacture area of this enterprise has been transformed into the Laijin Culture Creative Industrial Park.

The menu of Fanju (饭局) restaurant. Price unit: RMB, Time: 2018.

Zhizi Barbecue for multi-clients	Original price	Favourable price	
For two people	207	128	
For four people	313	218	
Hotpot for multi-clients	**Original price**	**Favourable price**	
For two people	230	138	
For four people	344	208	
Fried dish & Steamed Rice	**Price_RMB**	**Fried dish & Steamed Rice**	**Price_RMB**
Fried eggplant & Steamed rice	12	Fried eggs and rice	10
Mapo doufu & Steamed rice	10	Fried rice with soy sauce	12
Fish flavored pork slices	14	Yangzhou fried rice	14
Fried chilli & potato slices	10	Fried rice with beef	16
Kung Pao Chicken	14	Chinese chives scrambled eggs	12
Twice-cooked pork	14	Onion scrambled eggs	12
Fried beef with potatoes	16	Chilli scrambled rice	14
Stir-fried lamp with chinese leek	20	Fried Moo Shu Pork	14
Noodles	**Price_RMB**		
Noodles with tomato & egg	12		
Noodles with fried chilli & potato	12		
Noodles with braised beef in sauce	18		
Noodles in broth with shredded pork & vegetable	12		

Spinach egg noodles	12
Fried sauce noodles	15
Noodles with fried eggplant	12

Table 10A. The temperatures of three days in Beijing in 2018. Resource © CMA.

1601 2018	F°	C°	**0601 2018**	F°	C°	**1108 2018**	F°	C°
6	34.00	1.11	**6**	23.00	-5.00	**6**	80.00	26.67
8	33.00	0.56	**8**	22.00	-5.56	**8**	80.00	28.89
10	36.00	2.22	**10**	29.00	-1.67	**10**	84.00	30.56
12	38.00	3.33	**12**	34.00	1.11	**12**	87.00	31.11
14	40.00	4.44	**14**	37.00	2.78	**14**	88.00	30.00
16	39.00	3.89	**16**	35.00	1.67	**16**	86.00	28.33
18	35.00	1.67	**18**	33.00	0.56	**18**	83.00	28.89
20	31.00	-0.56	**20**	32.00	0.00	**20**	84.00	27.22
22	32.00	0.00	**22**	30.00	-1.11	**22**	81.00	-17.78

Table 11A. The population density of the selected enterprise CICs and their surrounding urban environment on 16th Jan, 2018. Data collected and inferred by the author based on heat map analysis.

Population density	**06:00**	**08:00**	**10:00**	**12:00**	**14:00**	**16:00**	**18:00**	**20:00**	**22:00**
798_IH	3800.00	21800.00	40066.67	38666.67	37400.00	39333.33	21000.00	11666.67	8333.33
798_area	4042.11	20084.21	41178.95	42442.11	38147.37	41557.89	29726.32	17936.84	12421.05
Laijin_IH	3619.05	8190.48	37523.81	37714.29	35238.10	34285.71	36190.48	17333.33	20000.00
Laijin_Area	9422.222222	19911.11111	33955.55556	34400	32000	34666.66667	38488.88889	27555.55556	33777.77778
898_IH	875.00	3875.00	11625.00	11750.00	8500.00	11000.00	8500.00	4750.00	4000.00
898_area	5040.00	9760.00	15520.00	15120.00	12960.00	14480.00	17760.00	14640.00	15200.00
Urban environment	8658.23	13096.31	26188.22	26208.04	24986.24	26137.59	27018.16	21285.64	20785.91
RH_to the north of Laijin	14500.00	30166.67	30833.33	31500.00	29166.67	35000.00	40500.00	36500.00	45833.33

Table 12A. The population density of the selected enterprise CICs and their surrounding urban environment on 6th Jan, 2018. Data collected and inferred by the author based on heat map analysis.

Population density	**06:00**	**08:00**	**10:00**	**12:00**	**14:00**	**16:00**	**18:00**	**20:00**	**22:00**
798_IH	2133.33	15133.33	21533.33	21533.33	21466.67	31600.00	17466.67	10733.33	7600.00
798_area	2442.11	14442.11	22778.95	24673.68	23031.58	30821.05	22357.89	14021.05	11494.74
Laijin_IH	4190.48	6857.14	16952.38	20000.00	21523.81	17904.76	19238.10	14666.67	14666.67
Laijin_Area	11644.4444	20000	26933.3333	33866.6666	29155.5555	28800	32622.2222	29066.6666	33066.6666
898_IH	875.00	1875.00	2375.00	4750.00	3750.00	3875.00	3375.00	3000.00	2875.00
898_area	5120.00	10640.00	13440.00	16480.00	12080.00	15040.00	16080.00	13520.00	14400.00
Urban environemnt	6978.53	13822.78	21393.51	24171.71	21246.01	22760.59	23214.08	20675.84	20356.63
RH_to the north of Laijin	18166.67	31500.00	35666.67	46000.00	35833.33	38333.33	44333.33	41666.67	49166.67

Table 13A. The population density of the selected enterprise CICs and their surrounding urban environment on 11th Aug, 2018. Data collected and inferred by the author based on heat map analysis.

Population density	**06:00**	**08:00**	**10:00**	**12:00**	**14:00**	**16:00**	**18:00**	**20:00**	**22:00**
798_IH	3200.00	6666.67	19466.67	31733.33	38133.33	39466.67	32800.00	17466.67	13200.00
798_area	3621.05	8084.21	21305.26	29726.32	34442.11	36631.58	32252.63	23915.79	16757.89
Laijin_IH	2666.67	8761.90	14857.14	16000.00	25904.76	17142.86	21333.33	14095.24	22857.14
Laijin_Area	7288.888889	20088.88889	27377.77778	30400	30400	29511.11111	32711.11111	28800	38044.44444
898_IH	1250.00	3000.00	5000.00	7250.00	4750.00	5750.00	6250.00	4250.00	3750.00
898_area	4800.00	9280.00	15840.00	14880.00	14400.00	12960.00	15200.00	15040.00	16320.00
Urban environment	5494.77	13397.91	21358.28	22472.21	22111.17	22828.84	22670.34	18879.47	24462.30
RH_to the north of Laijin	11333.33	30000.00	38333.33	43000.00	34333.33	40333.33	42666.67	41666.67	51333.33

Table 14A. Pie data of the summary of specific land use distribution (proportion of area) in fragmented boundary spaces of three campus CICs including BUAA, USTB and PUHSC. Data collected and inferred by the author based on heat map analysis.

Subtype of functions	**BUAA**	**PUHSC**	**USTB**
1. Office	0.321	0.051	0.374
2. Teaching/Research	0.116	0.198	0.187
3. Kindergarten	0.037	0.000	0.000
4. Primary. school	0.000	0.021	0.038
5. Junior/Senior middle school	0.000	0.060	0.148
6. Market and Shops	0.027	0.003	0.000
7. Hotel	0.066	0.014	0.013
8. Canteen, Café and Restaurant	0.103	0.012	0.006
10. Hospital	0.007	0.578	0.000
11. Bank	0.059	0.010	0.013
12. Post office	0.011	0.000	0.000
16. Conference hall	0.023	0.000	0.000
20. Gym for aquatic	0.019	0.000	0.000
21. Health club	0.018	0.000	0.021
24. Student dormitory	0.109	0.000	0.000
25. Commercial and residential building	0.015	0.000	0.000
26. Green space	0.055	0.052	0.187

Table 15A. Pie data of the summary of specific land use distribution (proportion of area) in inner spaces of three campus CICs including BUAA, USTB and PUHSC. Data collected and inferred by the author based on heat map analysis.

Subtype of functions	BUAA_inner	PUHSC_inner	USTB_inner
1. Office	0.168	0.114	0.200
2. Teaching/Research	0.161	0.182	0.083
3. Kindergarten	0.011	0.003	0.000
4. Primary. school	0.014	0.000	0.000
5. Junior/Senior middle school	0.019	0.000	0.000
6. Market and Shops	0.007	0.013	0.017
8. Canteen, Café and Restaurant	0.014	0.021	0.024
9. Service centre and Stuff club	0.010	0.021	0.010
10. Hospital	0.004	0.012	0.003
11. Bank	0.004	0.000	0.017
14. Theatre and cinema	0.007	0.000	0.000
15. Museum and Gallery	0.026	0.000	0.005
16. Conference hall	0.003	0.018	0.008
18. Library	0.016	0.015	0.017
19. Gym for ball game	0.037	0.014	0.009
21. Health club	0.015	0.000	0.010
22. Other infrastructure	0.015	0.019	0.017
23. Staff dormitory	0.189	0.267	0.230
24. Student dormitory	0.074	0.120	0.138
26. Green space	0.202	0.164	0.203

Table 16A. Pie data of the summary of specific land use distribution (proportion of area) in inner and fragmented boundary spaces of three campus CICs including BUAA, USTB and PUHSC. Data collected and inferred by the author based on heat map analysis.

Main type of functions	BUAA _inner	PUHSC _inner	USTB _inner	BUAA_ boundary	PUHSC_ boundary	USTB_ boundary
Institution	393136.5374	174581.7341	224794.82	458653.21	12420.941	87023.57
Schools	52038.402	1780.911	0	0	17802.393	28448.4766
Service	39767.0375	35612.997	38272.128	99532.34	177229.018	4102.37
Cultural facility	60335.064	19691.62	35130.74435	0	0	0
Sport	69330.63	11088.3785	20077.18	0	0	3212.27
Other infrastructure	19566.481	10107.924	5340.061	967.118	106.7614	1322.25
Residence	314447.056	231181.6629	330834.695	113556.246	0	0
Green space	239585.7384	95223.85751	166469.2331	38918.8786	11403.54032	28591.48798

Table 17A. The population density in Pingyao (people/km^2). Data collected and inferred by the author based on heat map analysis.

Time	Weekday		Weekend	
	Old town	Total urban area	Old town	Total urban area
10:00	1334.67	2438.53	2288.00	4048.08
18:00	1277.47	2299.83	3355.73	5670.54
22:00	1944.80	4219.04	3584.53	5641.51

Table 18A. The GDP of urban district in Datong

Year	Urban District Population (Thousand)	Primary Industry GDP (Million RMB)	Secondary Industry GDP (Million RMB)	Tertiary Industry GDP (Million RMB)
1999	1279.8	339.68	7098.08	5443.41
2000	1322.6	433.49	7413.12	5881.3
2001	1349.9	253.46	8736.96	6415.32
2002	1377.3	373.27	10123.04	7260.99
2003	1399	419.15	12320.9	7541.44
2004	1426.1	474.31	15394.73	8489.03
2005	1438.2	606.83	16796.25	12522.93
2006	1490.5	635.99	18010.95	14323.4
2007	1514.1	926.64	21172.52	17035.86
2008	1533.7	1013.03	24206.58	19710.61
2009	1546.9	725.58	10925.94	9711.54
2010	1559.1	478.35	29260.68	26648.23
2011	1565.5	976.59	36487.26	30370.94
2012	1567.7	989.94	40512.77	33698.9
2013	1766.3	1094.67	38768.76	37560.15
2014	1775.3	1027.67	37927.53	40146.09
2015	1782.4	1202.06	38717.04	45942.83
2016	1791	1279.26	31850.56	48737.36
2017	1802.8	1301.91	34167.64	53194.33

Other relevant figures

Figure 19A. Analysis on the original satellite map including BUAA, PUHSC and USTB. Resource © Google map.

Figure 20A. Analysis on the original satellite map including PKU and THU. Resource © Google map.

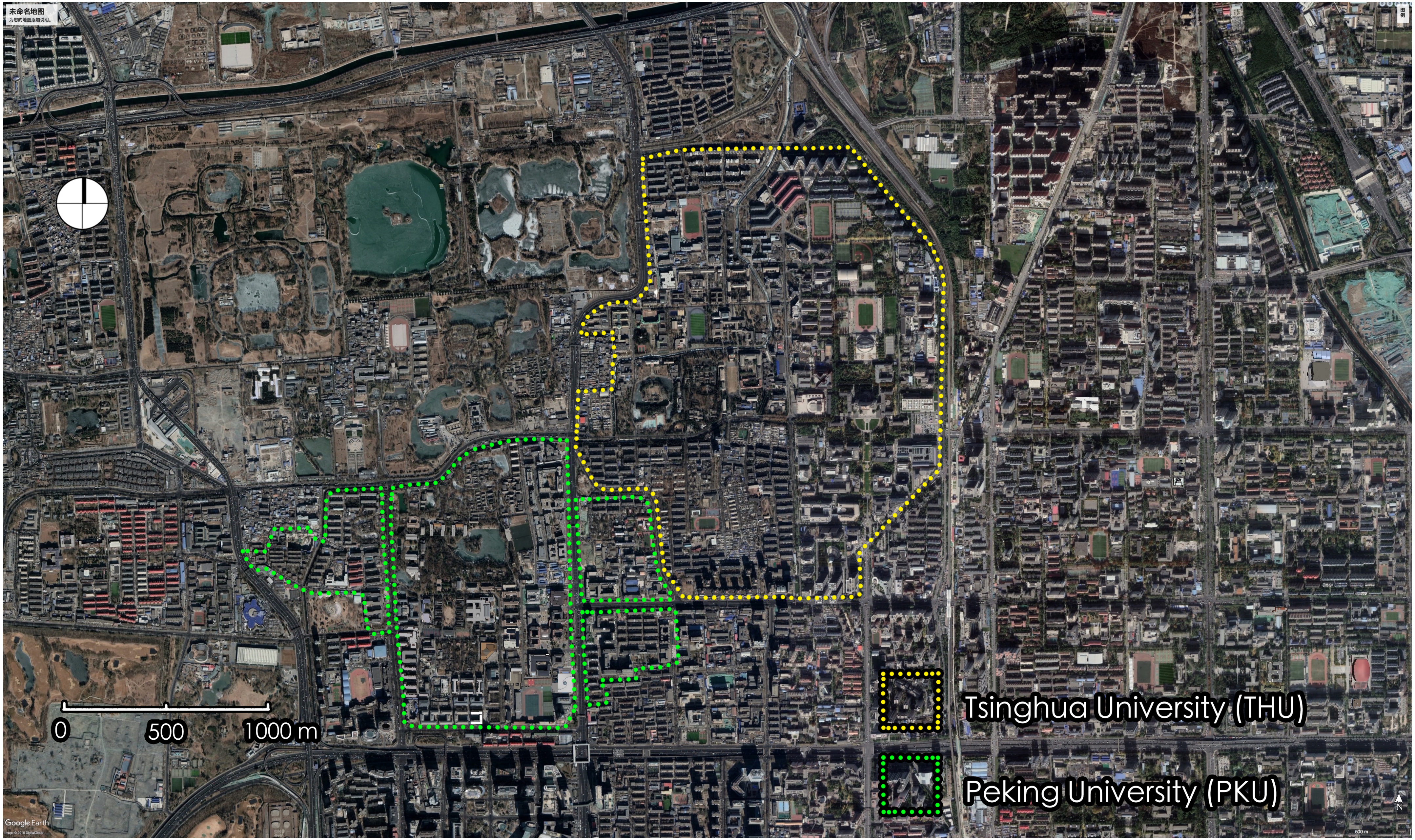


Figure 21A. Analysis on the original satellite map including Beijing CBD. Resource © Google map.

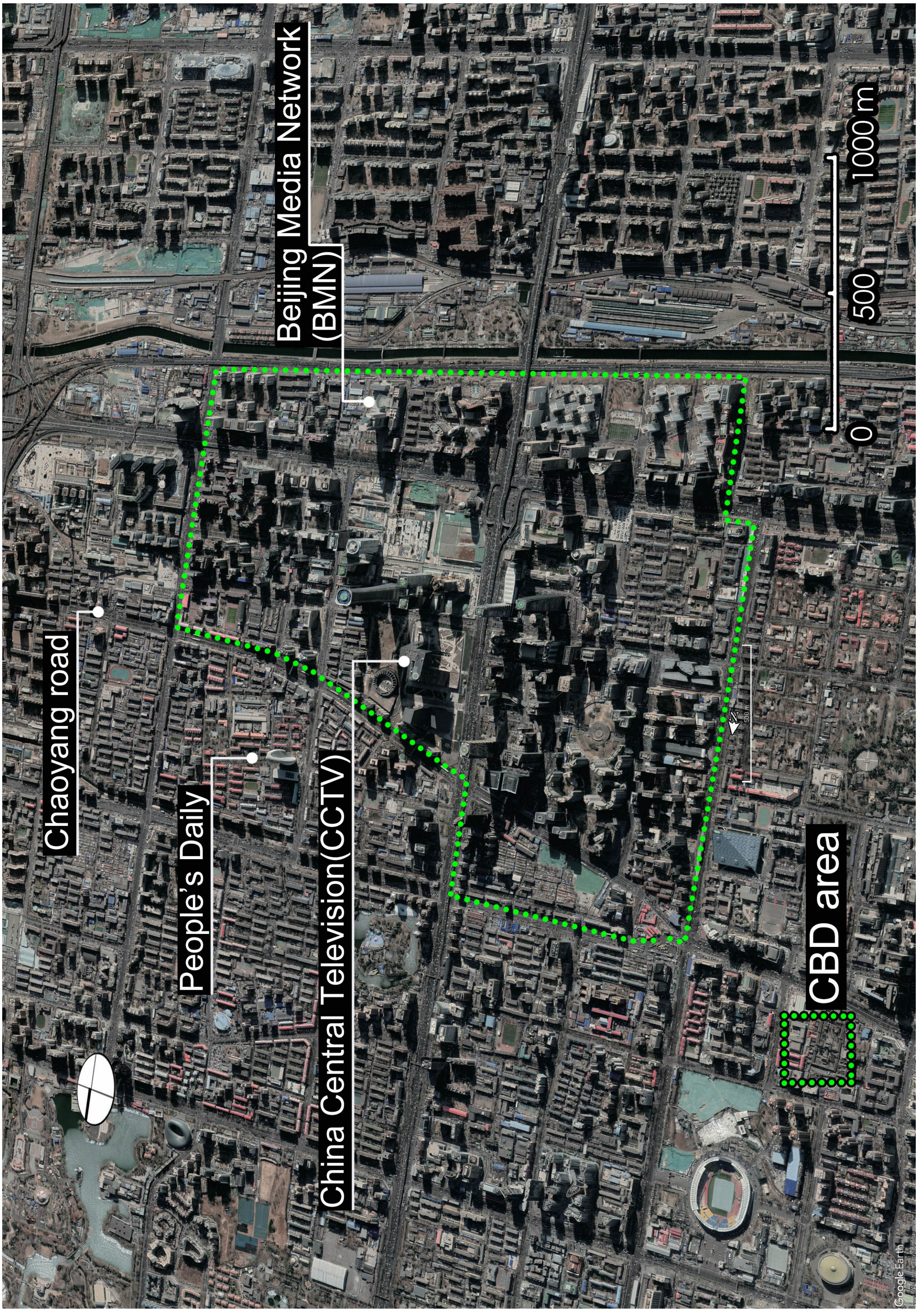


Figure 22A. The original satellite map of Datong ancient city. Resource © Google map.

Figure 23A. The original satellite map of urban Datong. Resource © Google map.

Figure 24A. The original satellite map of Pingyao ancient city. Resource © Google map.

Figure 25A. The original satellite map of Pingyao. Resource © Google map.

Figure 26A. University staff and student residence buildings and related commercial buildings of Beijing's campuses. Resource © (Gu et al., 2019).

Figure 27A. Scenes of three university campus in street community named Huayuan Lu. Resource © (Gu et al., 2019)

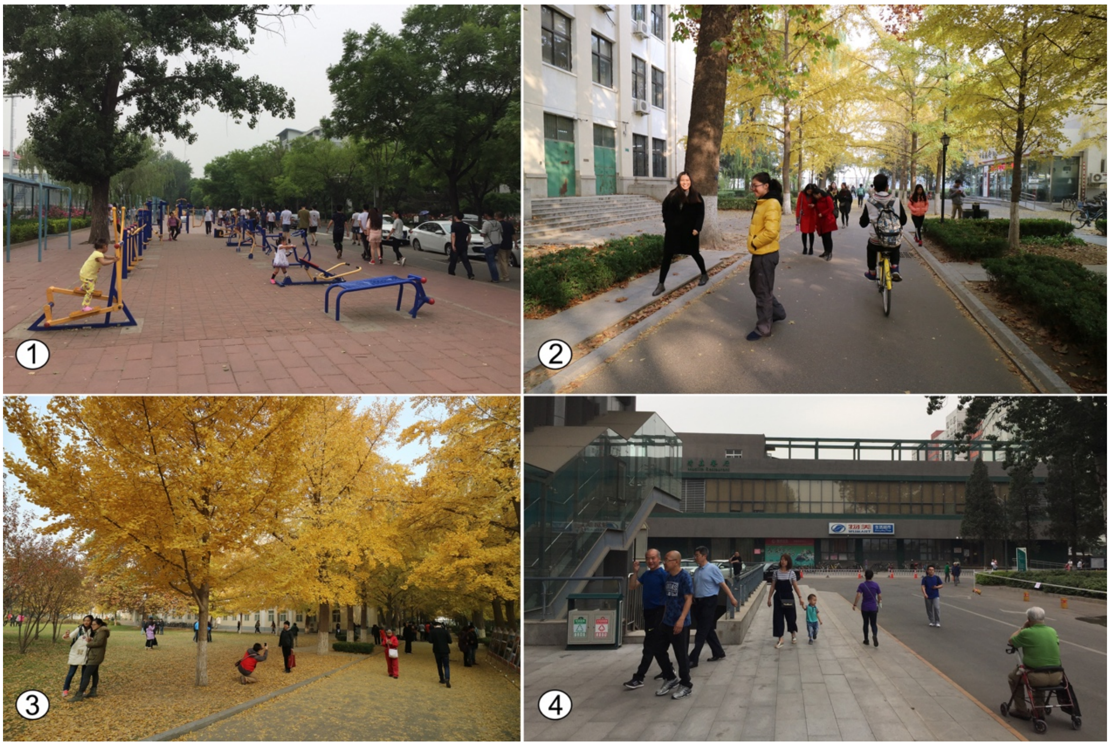


Figure 28A. The playground in front of the high-rise student dormitory build inside the old campus of Xi'an University of Architecture and Technology. Not only the students but also the children of the teachers share the public spaces and many teacher's apartment buildings are also located in this campus, which makes the collective life inside the campus very spatially mixed and diversified. For resolving the problem of population growth and over-aggregation, this university has built its new huge campus far-away to the south-west of the centre urban area. Photo taken by the author in 2019.

Figure 29A. The dormitory building inside the old campus of Xi'an University of Architecture and Technology. From this photo, it could be seen that one side of the building has a half-underground floor functioning for shops opened to the campus street. Photo taken by the author in 2019.

Figure 30A. The inside of the canteen named Yan Xiang Yuan nearby the dormitory building in the old campus of Xi'an University of Science and Technology. Most canteens in campus cater students and stuff with three meals of everyday. In some universities, the students and teachers can stay inside the campus for weeks or months. Photo taken by the author in 2019.

Figure 31A. The 5th student dormitory building behind the nearby canteen named Yanxiangyuan (the left and low building). These buildings are all located in the old campus of Xi'an University of Science and Technology, which is close to Xi'an University of Architecture and Technology. A large number of undergraduate students have moved to the newly built campus in the urban peripheral university city. Photo taken by the author in 2019.

Reference

ALEKSANDRA, B. & MILENA, K. Environmantal aspects of the housing - a case study of transformed neighbourhood " GRBAVICA" in NOVI SAD, PhIDAC 2012. *In:* GRDIC, Z. & TOPLICIC-CURCIC, G., eds. IV International symposium for students of doctoral studies in the field of civil engineering, architecture and environmental protection, 2012. University of Nis, Faculty of Civil Engineering and Architecture, 12-18.

ALLAN, S. 1984. The myth of the Xia Dynasty. *Journal of the Royal Asiatic Society,* 116**,** 242-256.

ALLEN, R. & RICHARDS, D. S. 1999. *The Cambridge history of ancient China: From the origins of civilization to 221 BC*, Cambridge University Press.

ALSFORD, N. J. 2019. The City within the City: A Glimpse of Elite Formation in Deptford, London and Dadaocheng, Taipei. *Journal of Urban History***,** 0096144219868815.

ANGOTTI, T. & HANHARDT, E. 2001. Problems and prospects for healthy mixed-use communities in New York City. *Planning Practice Research Policy,* 16**,** 145-154.

ARCHAEOLOGICAL TEAM OF NO. 1A FOCUSING ON REMAINS OF LUOYANG CITY BETWEEN HAN AND WEI DYNASTIES, A. 1998. Trial Excavation of Luo' yang City-Walls from the Han-Wei Period. *Kaogu Xuebao***,** 361-388.

BAMAKHRAMA, S. S. 2015. *Cities within cities: An urbanization approach in the gulf countries.* UCLA.

BEIJING MUNICIPAL BUREAU OF STATISTICS, B. & BEIJING, N. S. O. I. 2018. *The Statistical Yearbook of Beijing in 2018* [Online]. Beijing: China Statistics Press. Available: http://tjj.beijing.gov.cn/nj/main/2018-tjnj/zk/indexch.htm [Accessed].

BEIJING MUNICIPAL EDUCATION COMMISSION, B. 2018. *Beijing Education Development Statistics of 2017-2018 School Year* [Online]. Beijing: Beijing Municipal Education Commission. Available: http://www.beijing.gov.cn/zfxxgk/110003/jysytj32/2018-07/04/content_03b3b89303c148f4a55bef1f90057293.shtml [Accessed].

BERRY, B. J. 1964. Cities as systems within systems of cities. *Papers in regional science,* 13**,** 147-163.

BIAN, Y. 1997. Bringing strong ties back in: Indirect ties, network bridges, and job searches in China. *American sociological review*, 366-385.

BIAN, Y. & LOGAN, J. R. 1996. Market transition and the persistence of power: The changing stratification system in urban China. *American Sociological Review*, 739-758.

BLIZNAKOV, M. 1993. Soviet housing during the experimental years, 1918 to 1933. *Russian housing in the Modern Age: design social history*, 85-148.

BOGDANOV, A. 1923. *A short course of economic science,* London, UK: Labour Publishing Company.

BOND, M. H. & HWANG, K. K. 2008. The psychology of the Chinese people. *In:* BOND, M. H. (ed.) *The psychology of the Chinese people.* Hong Kong: The Chinese University Press.

BORSDORF, A., HIDALGO, R. & SÁNCHEZ, R. 2007. A new model of urban development in Latin America: The gated communities and fenced cities in the metropolitan areas of Santiago de Chile and Valparaíso. *Cities,* 24, 365-378.

BRAY, D. 2005. *Social space and governance in urban China: The danwei system from origins to reform*, Stanford University Press.

BRAY, D. 2006. Building ‘community’: New strategies of governance in urban China. *Economy Society,* 35, 530-549.

BREITUNG, W. 2012. Enclave urbanism in China: Attitudes towards gated communities in Guangzhou. *Urban geography,* 33, 278-294.

BROWN, S. C., MASON, C. A., PERRINO, T., LOMBARD, J. L., MARTINEZ, F., PLATER-ZYBERK, E., SPOKANE, A. R. & SZAPOCZNIK, J. 2008. Built environment and physical functioning in Hispanic elders: the role of “eyes on the street”. *Environmental health perspectives,* 116, 1300-1307.

BRUNSON, K., HE, N. & DAI, X. 2016. Sheep, cattle, and specialization: New zooarchaeological perspectives on the Taosi Longshan. *International Journal of Osteoarchaeology,* 26, 460-475.

BUAA, S. H. M. 2017. Ariscape of BUAA in 50 years ago. *EROSAPACE KNOWLEDGE.* Beijing: Chinese Society of Aeronautics and Astronautics (CSAA).

CAI, Y. 2006. *State and laid-off workers in reform China: the silence and collective action of the retrenched*, Routledge.

CAI, Y. & YU, L. 2016. The structure of ChengZhou in Western Zhou and related questions.

Cultural Relics of Central China, 1.

CAO, C. 2014. *Thoughts on the Economic Transformation of Datong City* [Online]. Taiyuan: Shanxi Statistical Information Network. Available: http://www.kelamayi.com.cn/fzdl/2014-04/22/content_1150518.htm [Accessed].

CASTILLO, G. 1997. Soviet orientalism: Socialist realism and built tradition. *Traditional Dwellings Settlements Review*, 33-47.

CHEN, W. (ed.) 1991. *Atlas of Chinese Agricultural Science and Technology History,* Beijing: Agricultural press.

CHENG, K. & HSU, S. 1980. *Historical Atlas of China,* Taipei, Chinese Culture University Press.

CHENG, P. 2009. The analysis of Wangchenggang remains in Dengfeng. *Kaogu & Wenwu***,** 52-56.

CHIANG, Y.-C. & DENG, Y. 2017. City gate as key towards sustainable urban redevelopment: A case study of ancient Gungnae City within the modern city of Ji'an. *Habitat International,* 67**,** 1-12.

CHIEN, S.-S. 2009. Prefectures and prefecture-level cities: the political economy of administrative restructuring. *China's Local Administration.* Routledge.

CHINA, M. O. E. O. T. P. S. R. O. 1998-2018. *National Statistical Report on Education Development* [Online]. Available: http://www.moe.gov.cn/jyb_sjzl/sjzl_fztjgb/ [Accessed].

CHINA TECH INSIGHT, T. 2017. *WeChat User & Business Ecosystem Report* [Online]. Available: https://technode.com/2017/04/24/wechat-user-business-ecosystem-report-2017/ [Accessed].

CHRISTALLER, W. 1966. *Central places in southern Germany*, Prentice Hall.

CHUNG, J. H. & LAM, T.-C. 2009. *China's local administration: traditions and changes in the sub-national hierarchy*, Routledge.

COZENS, P. & HILLIER, D. 2012. Revisiting Jane Jacobs’s ‘Eyes on the Street’ for the Twenty-First Century: Evidence from Environmental Criminology. *The urban wisdom of Jane Jacobs.* Routledge.

CRANE, R. 1996. On form versus function: Will the new urbanism reduce traffic, or increase it? *Journal of Planning Education Research Policy,* 15**,** 117-126.

CRAWFORD, G., UNDERHILL, A., ZHAO, Z., LEE, G., FEINMAN, G., NICHOLAS, L., LUAN, F., YU, H., FANG, H. & CAI, F. 2005. Late Neolithic plant remains from northern China: preliminary results from Liangchengzhen, Shandong. *Current Anthropology,* 46, 309-317.

CROMARTIE, J. & BUCHOLTZ, S. 2008. Defining the" rural" in rural America.

CROWLEY, U. 2009. Genealogy, method. *In:* KITCHIN, R. & THRIFT, N. (eds.) *International Encyclopaedia of Human Geography* Elsevier.

CURRIER, J. 2008. Art and power in the new China: An exploration of Beijing's 798 district and its implications for contemporary urbanism. *Town Planning Review,* 79, 237-265.

DAI, L., LI, Z., ZHAO, C., YUAN, J., HOU, L., WANG, C., FULLER, B. & HU, Y. 2016. An isotopic perspective on animal husbandry at the Xinzhai site during the initial stage of the legendary Xia dynasty (2070–1600 BC). *International Journal of Osteoarchaeology,* 26, 885-896.

DE KOE, D. & HVA, P. D. B. 2013. *Urban vitality through a mix of land-uses and functions: an addition to citymaker*.

DELCLÒS-ALIÓ, X., GUTIÉRREZ, A. & MIRALLES-GUASCH, C. 2019. The urban vitality conditions of Jane Jacobs in Barcelona: Residential and smartphone-based tracking measurements of the built environment in a Mediterranean metropolis. *Cities,* 86, 220-228.

DEMOGRAPHIC YEARBOOK, D. 2007. *United Nations Statistics Division, 2007 Demographic Yearbook: table 6.* [Online]. Available: https://unstats.un.org/unsd/demographic/products/dyb/dyb2007/notestab06.pdf [Accessed].

DENG, F. 2017. Gated community and residential segregation in urban China. *GeoJournal,* 82, 231-246.

DENG, F. 2018. Work unit and private community in the evolution of urban planning in contemporary China. *Planning Theory,* 17, 533-550.

DENG, G. 2002. *The premodern Chinese economy: structural equilibrium and capitalist sterility*, Routledge.

DIJKSTRA, L. & POELMAN, H. 2014. A harmonised definition of cities and rural areas: the new degree of urbanisation. *WP,* 1, 2014.

DING, C. 2003. Land policy reform in China: assessment and prospects. *Land use policy,* 20, 109-120.

DING, H. 2011. China's 'Socializing Social Welfare' policy: a study on service quality in society-run homes for the aged in Beijing. *China Journal of Social Work,* 4, 137-151.

DOBROSZYCKI, L. 1987. *The chronicle of the Lodz ghetto, 1941-1944*, Yale University Press.

DONG, G. 2006. *50 years' evolution record of ancient capital Beijing,* Nanjing, Southeast University Press.

DONG, J. 1988. *The construction of ancient Chinese city* Beijing, China Building Industry Press.

DONG, W. 2018. Changes in Feng Shui for Urban Development. *Urban Planning*.

DU, C. 2017. *Who killed the Ming dynasty,* Beijing, World Affairs Press.

DU, Z. 1998. Archaeological Investigation Report of Er Fang palace in Qin dynasty. *Wen Bo*, 3-16.

DUARTE, R. H. 2013. The City Within the City: the University City, History and Urbanism in a Latin American Case Study. *Iberoamericana*, 7-25.

EBREY, P. B. 2010. The Cambridge History of China. Volume 5, Part 1, The Sung Dynasty and Its Precursors, 907-1279 by Denis Twitchett; Paul Jakov Smith. *Journal of Asian Studies,* 69, xxiii-890.

ERLITOU ARCHAEOLOGICAL TEAM OF INSTITUTE OF ARCHAEOLOGY IN CASS, C. I. 2005. Recent Archaeological Discoveries in the Central Area of the Erlitou Site in Yanshi City, Henan. *Archaeology,* 7.

F.A.HANSON 1991a. *The Application of Demographics in Archeology,* Xian, Sanqin Publishing House.

F.A.HANSON 1991b. *Demographic analysis and archeology study,* Xian, Sanqin Publishing House.

FANG, Y. & XU, W. 2010. A preliminary exploration of the population issue in Luoyang, East Han. *JOURNAL OF HENAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (SOCIAL SCIENCE),* 28, 5-8.

FINCHER, C. L. & THORNHILL, R. 2012. Parasite-stress promotes in-group assortative sociality: The cases of strong family ties and heightened religiosity. *Behavioral Brain Sciences,* 35, 61-79.

FOUCAULT, M. 1978. Nietzsche, genealogy, history.

FOX, R. G. 1977. *Urban anthropology: cities in their cultural settings*, Prentice Hall.

FRANK, L. D., SCHMID, T. L., SALLIS, J. F., CHAPMAN, J. & SAELENS, B. E. 2005. Linking objectively measured physical activity with objectively measured urban form: findings from SMARTRAQ. *American journal of preventive medicine,* 28**,** 117-125.

FREEMAN, M. A. 1997. Demographic correlates of individualism and collectivism: A study of social values in Sri Lanka. *Journal of Cross-Cultural Psychology,* 28**,** 321-341.

FU, X. 2001. *Research on Urban Planning, Layout of Building Group and Architectural Design Methods in Ancient China,* Beijing, China Building Industry Press.

GAO, J. 2007. A Preliminary Investigation on the Settlement Pattern of Taosi Ruins. *Zhongyuan Wenwu,* 3**,** 13-20.

GAO, J. 2013. The Tao’ si model for Chinese civilization and the origin of early nation. The Archaeology of Three Dynasties (Xia, Shang and Zhou).

GAO, M. 2015. *Anxious Shanxi: Is ” Coal Dominates" the Fundamental Reason Affecting Shanxi's Economic Development?* [Online]. Pengpai News. Available: https://www.thepaper.cn/newsDetail_forward_1384332 [Accessed].

GAUBATZ, P. 1999. China's urban transformation: patterns and processes of morphological change in Beijing, Shanghai and Guangzhou. *Urban studies,* 36**,** 1495-1521.

GEREFFI, G. 2008. Development models and industrial upgrading in China and Mexico. *European Sociological Review,* 25**,** 37-51.

GERTH, K. 2017. Conclusion: Are Chinese Cities Becoming More Habitable? *The Habitable City in China.* Springer.

GODSCHALK, D. R. 2004. Land use planning challenges: Coping with conflicts in visions of sustainable development and livable communities. *Journal of the American Planning Association,* 70**,** 5-13.

GOLDSTEIN, B. D. 2013. *A City Within a City: Community Development and the Struggle Over Harlem, 1961-2001.* Ph.D. Doctoral dissertation, Harvard University.

GONG, R. 2007. Economic Disputes Caused by the Baojia System in Jiangxi During the Republic of China and Their Settlement: An Exploration Based on Baojia Litigation Archives in Yifeng and Wanzai. *Studies in Chinese Economic History,* 2007**,** 90-96.

GONG, S. 1991. Two records about Tang Chang'an city population. *Journal of Chinese Historical Geography*, 194.

GOSPODINI, A. 2006. Portraying, classifying and understanding the emerging landscapes in the post-industrial city. *Cities,* 23, 311-330.

GRANT, J. 2002. Mixed use in theory and practice: Canadian experience with implementing a planning principle. *Journal of the American Planning Association,* 68, 71-84.

GRAVA, S. 1993. The Urban Heritage of the Soviet Regime The Case of Riga, Latvia. *Journal of the American Planning Association,* 59, 9-30.

GRUBER, K. & ANGERER, F. 1952. *Die Gestalt der deutschen Stadt: ihr Wandel aus der geistigen Ordnung der Zeiten*, Callwey.

GU, Y. 2013. *Transformation of the place model of community: an exploration of the modernity issue based on the urbanization process.* Tsinghua University.

GU, Y. & WANG, C. 2018. *Design Thinking By Hand-Painted Expression,* Beijing, Tsinghua University Press.

GU, Y., ZHAO, J., HERZOG, T., MAO, Q. & LATZ, P. 2019. Exploring the space use mechanism of high-density campus in urban Beijing. *Habitat International,* 91, 102024.

GUAN, Z., FANG, X., LIU, J. & LIU, X. 2015. *GUAN ZI,* Shanghai, Shanghai Ancient Books Publishing House.

GUO, K. & YAO, Y. 2004. The Causes of The Restructuring of State-owned Enterprises: The Test of Five Hypothesiss. *The Journal of World Economy*, 3-13.

GUO, L. 2017. *Atlas of Ancient Chinese History,* Beijing, Planet map press.

HALL, G. B. & ZHANG, J. D. 1988. Xian. *Cities,* 5, 114-126.

HAN, G. 1996. *The geography research of Beijing historical population,* Beijing, Beijing University Press.

HAN, J. 2002. Reexamine the city shape of Xianyang in Qin dynasty. *Wen Bo*, 37-39.

HARRIS, C. D. & ULLMAN, E. L. 1945. The nature of cities. *The Annals of the American Academy of Political Social Science,* 242, 7-17.

HARVEY, D. 1989. *The condition of postmodernity*, Blackwell Oxford.

HAY, D., MORRIS, D., LIU, G. & YAO, S. 1994. Economic reform and state-owned enterprises in China 1979-87. *OUP Catalogue*.

HE, C., HUANG, Z. & YE, X. 2014. Spatial heterogeneity of economic development and industrial pollution in urban China. *Stochastic environmental research risk assessment,* 28, 767-781.

HE, C., PAN, F. & YAN, Y. 2012. Is economic transition harmful to China' s urban environment? Evidence from industrial air pollution in Chinese cities. *Urban Studies,* 49, 1767-1790.

HE, Q., HE, W., SONG, Y., WU, J., YIN, C. & MOU, Y. 2018. The impact of urban growth patterns on urban vitality in newly built-up areas based on an association rules analysis using geographical 'big data'. *Land Use Policy,* 78, 726-738.

HE, Y. 1996. *The history of ancient Chinese urban planning*, China Building Industry Press.

HONG, X. 2004. A Preliminary Study into the Settlement Pattern of the Erlitou Site [J]. *Archaeology,* 11.

HONG XU, H. Z. 2004. The survey and excacation of the palace city and its peripheral roads in Yan' shi, Henan provience. *Archaeology*, 3-13.

HOU, R. 1986. Evolution of the city plan of Beijing. *Third World Planning Review,* 8, 5.

HOU, R. Exploring the Planning and Design of Yuan Dadu City. *In:* ZHENG, X., ed. Proceedings of the Forbidden City Society of China, 1997 Beijing. Forbidden City Press, 10-13.

HOU, W. 2016. An exploration of the location and construction of Cheng' zhou in late Western Zhou. *Archaeology,* 000, 90-97.

HSU, K. J. 2014. *Climate made history,* Beijing, SDX Joint Publishing Company.

HU, B. 1993. A brife exploration of the land system in Warring States period. *Journal of Hebei University: Philosophy and Social Sciences*, 32-37.

HU, X. & CAI, Z. 2013. The characteristics of residential density in ancient Chinese cities. *HUAZHONG ARCHITECTURE*, 128-131.

HUA, L. 2006. *Rebuilding China:30 Years of City Planning (1949-1979),* Beijing, Joint Publishing.

HUANG, Y. 2004. Housing inequality and residential segregation in transitional Beijing. From work-unit compounds to gated communities. *Restructuring the Chinese city: Changing society, economy Space and Culture*, 172-201.

HUANG, Y. 2006. Collectivism, political control, and gating in Chinese cities. *Urban geography,* 27, 507-525.

HUANG, Y. & CLARK, W. A. 2002. Housing tenure choice in transitional urban China: a multilevel analysis. *Urban studies,* 39**,** 7-32.

HUANG, Y. & XU, W. 2012. The study on Chang'an City's population geography of the Han Dynasty: Taking the population in A. D. 2 for example. *Journal of Northwestern University***,** 133-138.

HUDSON, H. D. 1986. " The Social Condenser of Our Epoch": The Association of Contemporary Architects and the Creation of a New Way of Life in Revolutionary Russia. *Jahrbücher für Geschichte Osteuropas***,** 557-578.

INSTITUTE OF ARCHAEOLOGY CHINESE ACADEMY OF SOCIAL SCIENCES, I. (ed.) 2004. *Chinese Archaeology: Western Zhou and Eastern Zhou,* Beijing: China Social Science Press.

IVESON, K. 2013. Cities within the city: Do-it-yourself urbanism and the right to the city. *International journal of urban and regional research,* 37**,** 941-956.

JACOBS, J. 1961. *The death and life of great American cities,* New York, Vintage Books.

JAHIEL, A. R. 1998. The organization of environmental protection in China. *The China Quarterly,* 156**,** 757-787.

JARGOWSKY, P. A. 1997. *Poverty and place: Ghettos, barrios, and the American city*, Russell Sage Foundation.

JEFFERSON, G. H. & RAWSKI, T. G. 1994. Enterprise reform in Chinese industry. *Journal of Economic Perspectives,* 8**,** 47-70.

JIANG, G. 2002. A Study on the Population Problems of the Major Capitals in the Eastern Zhou Dynasty. *Wenwu Chunqiu***,** 6-14.

JIN, X., LONG, Y., SUN, W., LU, Y., YANG, X. & TANG, J. 2017. Evaluating cities' vitality and identifying ghost cities in China with emerging geographical data. *Cities,* 63**,** 98-109.

JIXIA ACADEMY, J. & WEN, R. 1993. *The translation and annotation of Kaogong Ji,* Shanghai, Shanghai Ancient Books Publishing House.

KAN, C. & MA, Q. 2018. *Predicting the urban population flow with the help of deep learning.* [Online]. Beijing: Smart eye of Baidu map & China institute of planning and design. Available: https://mp.weixin.qq.com/s/_F67_toLIeo-Tw0n__Rzlw [Accessed].

KATOU, S. 1959. *A research on Chinese economic history（Three volumes）,* Beijing, The

Commercial Press.

KATZ, P., SCULLY, V. & BRESSI, T. W. 1994. *The new urbanism: Toward an architecture of community*, McGraw-Hill New York.

KING, K. 2013. Jane Jacobs and 'the need for aged buildings' : Neighbourhood historical development pace and community social relations. *Urban Studies,* 50**,** 2407-2424.

KONG, Q. 2014. *A study on structures of ancient city gates and ceremonial archway of Beijing,* Beijing, Oriental Press.

KOPP, A. 1970. *Town and revolution: Soviet architecture and city planning, 1917-1935*, George Braziller.

KOSTOF, S. & NORWICH, J. J. 1993. The City Shaped Urban Patterns and Meaning Throughout History. Boston: Little Brown and.

KREICHAUF, R. 2015. Ghettos in small towns? The research on ethnic segregation and stigmatisation processes in small town Germany. *Sociologica,* 9**,** 0-0.

KULASH, W., ANGLIN, J. & MARKS, D. 1990. *Traditional neighbourhood development: will the traffic work?*

LAI, X. 1991. An research on the development of population in Luo' yang during different dynasties. *Heluo Chunqiu.*

LAU, R. W. 2001. Socio-political control in urban China: changes and crisis. *The British journal of sociology,* 52**,** 605-620.

LEI, C., CHEN, S. & LIN, X. 1995. *The history of Chinese palaces,* Taipei, Wenjin Publishing House.

LI, B., LIU, H., WU, L., MCCLOSKEY, T. A., LI, K. & MAO, L. 2014. Linking the vicissitude of Neolithic cities with mid Holocene environment and climate changes in the middle Yangtze River, China. *Quaternary International,* 321**,** 22-28.

LI, H. A study on the population classification of capital city xianyang of Qin dynasty. Research on Qin Capital Xianyang and Qin Culture: Proceedings of Qin Culture Symposium, 2001 Xian. Research Association of Qin Culture.

LI, H. 2005a. *The research on urban layout of capital city Dong' jing in North Song dynasty* Zhengzhou university.

LI, H. 2017. *A study on the urban construction and form of Bianjing in Northern Song,* Beijing, China Architecture & Building Press.

LI, J. 2007. *Country, Space and Society: Study on the Spatial Evolution of Ancient Luoyang Capital City,* Xi' an, Sanqin Publishing House.

LI, L., XING, X., XIA, H. & HUANG, X. 2016. Entropy-weighted instance matching between different sourcing points of interest. *Entropy,* 18, 45.

LI, L., ZHU, C., JIANG, F., ZHAO, Q. & LIN, I. 2008. Research on the disappearance causes of the Teng 'hua' luo Site in Lianyungang, Jiangsu Province, China. *Chinese Science Bulletin,* 53, 161-176.

LI, M., MA, Y., SUN, X., WANG, J. & DANG, A. 2018. APPLICATION OF SPATfAL AND TEMPORAL ENTROPY BASED ON MULTI-SOURCE DATA FOR MEASURING THE MIX DEGREE OF URBAN FUNCTIONS. *Urban Planning*, 97-103.

LI, S. (ed.) 2005b. *"What have we learned so far?" Restructuring the Chinese city: changing society, economy and space,* London and New York: Routledge.

LI, S.-M. 2003. Housing tenure and residential mobility in urban China: a study of commodity housing development in Beijing and Guangzhou. *Urban Affairs Review,* 38, 510-534.

LI, Z. 2009. *Notes and translation of Chun Qiu (book II),* Beijing, The Commercial Press.

LIANG, S. 1949. The city' s form and its planning. *People's Dail.* Beijing: People's Daily Publishing.

LIANG, Z. & JIA, X. 2017. Further Discussion on the remains and typology of Yaowang city. *Beifang Wenwu*, 29-34.

LIANG, Z., ZHANG, D. & LIU, H. 2015. Investigation and excavation of the Ruanwangcheng Site in Rizhao City, Shandong Province in 2012. *Archeology*, 7-24.

LIANYUNGANG MUSEUM, L. 2013. *Teng' hua' Luo: an ancient remains in Longshan culture times* [Online]. Lianyungang. Available: http://www.lygmuseum.cn/plus/view.php?aid=293 [Accessed].

LIN, N. & BIAN, Y. 1991. Getting ahead in urban China. *American Journal of Sociology,* 97, 657-688.

LIN, Y. 1986. Several questions about the early state form of China. *Jilin University Journal Social Science*, 1-12.

LINCOLN, T. & TAO, X. 2017. Introduction: The Habitable City in Chinese History. *The Habitable City in China.* Springer.

LIU, C. 2004. *A Study on The Capital City Bianjing in Northern Song,* Beijing, Science Press.

LIU, D. (ed.) 2009. *Ancient Chinese Architecture History. 2nd Edition,* Beijing: China Building Industry Press.

LIU, L. 2003. " The products of minds as well as of hands": Production of prestige goods in the Neolithic and early state periods of China. *Asian Perspectives*, 1-40.

LIU, L. 2005. *The Chinese Neolithic: trajectories to early states*, Cambridge University Press.

LIU, X., HAN, S. S. & O'CONNOR, K. 2013. Art villages in metropolitan Beijing: A study of the location dynamics. *Habitat international,* 40, 176-183.

LOGAN, J. R., BIAN, Y. & BIAN, F. 1999a. Housing inequality in urban China in the 1990s. *International Journal of Urban Regional Research,* 23, 7-25.

LOGAN, J. R., BIAN, Y. & BIAN, F. 1999b. Housing inequality in urban China in the 1990s. *International Journal of Urban*

Regional Research, 23, 7-25.

LONG, Y. & HUANG, C. 2019. Does block size matter? The impact of urban design on economic vitality for Chinese cities. *Environment and Planning B: Urban Analytics and City Science,* 46, 406-422.

LONG, Y. & LIU, L. 2016. Transformations of urban studies and planning in the big/open data era: A review. *International Journal of Image and Data Fusion,* 7, 295-308.

LU, D. 2006. *Remaking Chinese urban form: modernity, scarcity and space, 1949-2005*, Routledge.

LU, X. & PERRY, E. J. 1997. *Danwei: The changing Chinese workplace in historical and comparative perspective*, Me Sharpe.

LUOYANG TANGCHENG TEAM OF INSTITUTE OF ARCHAEOLOGY IN CHINESE ACADEMY OF SOCIAL SCIENCES, L. 2003. Archaeological excavation Briefing of Luoyang City Wall in Sui and Tang Dynasties from 1995 to 1997. *Archaeology*, 48-55.

LYNCH, K. 1981. *A theory of good city form,* Cambridge, MIT press.

LYNCH, K. 1984. *Good city form*, MIT press.

MA, L. J. 2002. Urban transformation in China, 1949–2000: a review and research agenda. *Environment planning A,* 34, 1545-1569.

MA, L. J. & WU, F. (eds.) 2005. *Diverse Processes and reconstituted spaces,* New York: Routledge.

MARCHANT, L. 1981. THE CAMBRIDGE HISTORY OF CHINA, VOL 3, SUI AND TANG CHINA 589-906, PT 1-TWITCHETT, D. UNIV QUEENSLAND PRESS PO BOX 42, ST

LUCIA QUEENSLAND 4067, AUSTRALIA.

MARCUSE, P. 1989. 'Dual city' : a muddy metaphor for a quartered city. *International journal of urban regional research,* 13**,** 697-708.

MATTHEWS, J. W. & TURNBULL, G. K. 2007. Neighbourhood street layout and property value: The interaction of accessibility and land use mix. *The journal of real estate finance economics,* 35**,** 111-141.

MATTHEWS, M. 1989. Residence controls in present-day China. *Asian Affairs,* 20**,** 184-194.

MENG, X. 2000. *Labour market reform in China*, Cambridge University Press.

MINISTRY OF EDUCATION OF THE PEOPLE' S REPUBLIC OF CHINA, M. & DEVELOPMENT PLANNING DIVISION, D. 2017. *2017 Education Statistics* [Online]. Beijing: Ministry of Education of the People' s Republic of China. Available: http://www.moe.gov.cn/s78/A03/moe_560/jytjsj_2017/qg/ [Accessed].

MINISTRY OF EDUCATION OF THE PEOPLE' S REPUBLIC OF CHINA, M. & MINISTRY OF HUMAN RESOURCES AND SOCIAL SECURITY, M. 2018. *2017 National Statistical Bulletin on the Development of Education* [Online]. Beijing: Ministry of Education of the People' s Republic of China. Available: http://www.moe.gov.cn/jyb_sjzl/sjzl_fztjgb/ [Accessed].

MONTGOMERY, J. 1995. Editorial urban vitality and the culture of cities. Taylor & Francis Group.

MONTGOMERY, J. 1998. Making a city: Urbanity, vitality and urban design. *Journal of urban design,* 3**,** 93-116.

MORGAN, L. J. 2013. Gated communities: Institutionalizing social stratification. *The Geographical Bulletin,* 54**,** 24.

MORRIS, I. 2010. *Why the west rules-for now: The patterns of history and what they reveal about the future*, Profile books.

MORRIS, J., SHEEHAN, J. & HASSARD, J. 2001. From Dependency to Defiance? Work-Unit Relationships in China' s State Enterprise Reforms. *Journal of Management Studies,* 38**,** 697-717.

MUMFORD, L. 2011. "What is a City?" : Architectural Record (1937). *The City Reader.* Routledge.

MURAWSKI, M. 2017a. Introduction: crystallising the social condenser. *The Journal of*

Architecture, 22, 372-386.

MURAWSKI, M. 2017b. The Palace Complex: a Stalinist social condenser in Warsaw. *The Journal of Architecture,* 22, 458-477.

MURAWSKI, M. & RENDELL, J. 2017. The social condenser: a century of revolution through architecture, 1917–2017. *The Journal of Architecture,* 22, 369-371.

NANJING MUSEUM, N. 2014. *Teng 'hua' luo: Archaeological excavation report of neolithic sites in lianyungang city. ,* Beijing, Science Press (China).

NATIONAL BUREAU OF STATISTICS, P. 1981-2017. *China Statistical Yearbook* [Online]. Beijing: China Statistics Press. Available: http://www.stats.gov.cn/tjsj/ndsj/ [Accessed].

NICHOLAS, D. M. 2014. *The growth of the medieval city: from late antiquity to the early fourteenth century*, Routledge.

NIE, X. 2010. Examine the layout of King City of Zhou in Eastern Zhou based on archaeological discovery. *Zhongyuan Wenwu*, 51-55.

NIE, X. & CHENG, Y. 2017. Structure of Hanwei Luoyang Ancient Capital City and its impact. *Academic Journal of Zhongzhou,* 8, 122-125.

NISBETT, R. E. 2003. The geography of thought: How culture colours the way the mind works. New York, NY: The Free Press.

NIU, R. 2015. *The Study of Ancient Yecheng: The investigation of the origination of medieval capital city construction system in east Asia,* Beijing, Zhonghua Book Company.

NU, Z. Z. H. 2006. Floatation Results from the Remains Excavated on the Taosi City-site in 2002 and Their Analysis [J]. *Archaeology,* 5.

PAN, G. 2001. *History of ancient Chinese architecture: the architecture of Yuan and Ming dynasties.,* Beijing, China Construction and Industry Press.

PANG, X. & GAO, J. 2009. Explore the formation and preliminary development of early palace cities in China. *Archeology and Antiquities*, 46-51.

PANTSOV, A. V. & LEVINE, S. I. 2013. *Mao: the real story*, Simon and Schuster.

PATEMAN, T. 2011. Rural and urban areas: comparing lives using rural/urban classifications. *Regional trends,* 43, 11-86.

PIEKE, F. N. 2012. "Immigrant China." Modern China. 38, 40-77.

PIRENNE, H. 2014. *Medieval Cities: Their Origins and the Revival of Trade-Updated*

Edition, Princeton University Press.

PRYOR, R. J. 1968. Defining the rural-urban fringe. *Social Forces,* 47**,** 202-215.

QI, D. (ed.) 2003. *The Li Fang system of Wei, Jin, Sui, Tang: the archaeological evidences* Beijing: Beijing University Press.

QIAN, G. 2002. PRELIMINARY RESEARCH ON THE CHRONICLE AND EVOLUTION OF THE PLAN OF THE HAN AND WEI CAPITAL CITY LUOYANG. *Chinese Archaeology in the 21st Century and World Archeology: Commemoration of the 50th Anniversary of the Founding of the Institute of Archaeology, Chinese Academy of Social Sciences,* 50.

QIAN, G. 2016. The Evolution of the Capital City Typology of the Ancient Han and Tang Dynasties in China: An Exploring of the Origin of Chang'an City Form in Tang dynasty based on the understanding of Taiji Temple in Cao Wei Dynasty. *Zhongyuan Wenwu***,** 34-46.

QIAO, Y. 2004. History continuity of Beijing Unit Yard and Its Effect on Beijing Urban Space. *HUAZHONG ARCHITECTURE,* 22.

QU, F., HEERINK, N. & WANG, W. 1995. Land administration reform in China: its impact on land allocation and economic development. *Land Use Policy,* 12**,** 193-203.

QUAN, C., CHANG, H. & ZHANG, X. 2018. Analysis on the Characteristics of Spatial Layout for Qin Xianyang City Ruins. *Heritage and Conservation Studies***,** 144-147.

QUEST MOBILE, C. 2016. *Top 2000 Apps in China: Autumn 2016 review.* [Online]. Available: https://www.questmobile.com.cn/blog/en/blog_63.html [Accessed].

REN, X. 1997. *Tradition of the law and law of the tradition: Law, state, and social control in China*, Greenwood Publishing Group.

REN, X. & SUN, M. 2012. Artistic urbanization: creative industries and creative control in Beijing. *International journal of urban regional research,* 36**,** 504-521.

RENFREW, C. & BAHN, P. G. 1996. *Archaeology: theories, methods and practice*.

RITCHEY, T. Fritz Zwicky, morphologie and policy analysis. 16th EURO conference on operational analysis, Brussels, 1998a.

RITCHEY, T. General morphological analysis. 16th euro conference on operational analysis, 1998b Brussels.

RITCHIE, H. & ROSER, M. 2018. *Urbanization "Our World in Data"* [Online]. Available: https://ourworldindata.org/urbanization [Accessed].

ROBINSON, T. E. 2012. *A City Within a City: The Black Freedom Struggle in Grand Rapids, Michigan*, Temple University Press.

RODRÍGUEZ, D. A., KHATTAK, A. J. & EVENSON, K. R. 2006. Can new urbanism encourage physical activity?: Comparing a new Urbanist neighbourhood with conventional suburbs. *Journal of the American Planning Association,* 72**,** 43-54.

RODZINSKI, W. 1988. The Cambridge History of China. Vol. 1: the Ch'in and Han Empires, 221 BC-AD 220. Edited by Dennis Twitchett and Michael Loewe.(The Cambridge History of China, General Editors: Dennis Twitchett and John K. Fairbank.) pp. xli, 981, 17 maps, 18 tables. Cambridge etc., Cambridge University Press, 1986.£ 60.00. *Journal of the Royal Asiatic Society,* 120**,** 459-464.

ROGERSON, W. P. 1992. Contractual solutions to the hold-up problem. *The Review of Economic Studies,* 59**,** 777-793.

ROWLEY, A. 1996. Mixed-use development: ambiguous concept, simplistic analysis and wishful thinking? *Planning Practice & Research in Sociology of education,* 11**,** 85-98.

SAHARA, Y. & ZHANG, H. T. 2001. Re-exploring of Han Chang'an City Retest. *Archaeology and Antiquities***,** 85-93.

SAILER-FLIEGE, U. 1999. Characteristics of post-socialist urban transformation in East Central Europe. *GeoJournal,* 49**,** 7-16.

SCHALLER, M. & MURRAY, D. R. 2011. Infectious disease and the creation of culture. *In:* GELFAND, M. J., CHIU, C.-Y. & HONG, Y.-Y. (eds.) *Advances in Culture and Psychology: Volume 1.* Oxford Scholarship Online.

SECURITIES TIMES, C. 2019. *Tencent's first half profit rises 25%* [Online]. Xinhua Net. Available: http://www.xinhuanet.com/fortune/2019-08/15/c_1210242801.htm [Accessed].

SHANXI PROVINCIAL INSTITUTE OF ARCHAEOLOGY, S. 2005. *The historic sites of Yu'wang city* [Online]. Taiyuan. Available: http://www.sxkaogu.net/webshow/aritcleDetail.shtml?articleId=2006 [Accessed].

SMITH, M. 1989. "The earliest cities." Urban Life: Readings in Urban Anthropology, edited by George Gmelch and Walter Zenner. 91**,** 454-460.

SMITH, M. E., UR, J. & FEINMAN, G. M. 2014. Jane Jacobs' 'cities first' model and archaeological reality. *International Journal of Urban and Regional Research,* 38**,** 1525-1535.

SMITH, P. J. & VON GLAHN, R. 2003. Song-Yuan-Ming Transition in Chinese History.

SOLINGER, D. J. 2002. Labour market reform and the plight of the laid-off proletariat. *The China Quarterly,* 170**,** 304-326.

SONG, Z. 1993. A probe of population in Xia and Shang dynasties. *History Study***,** 93-107.

SONG, Z. 1994a. *The history of social life in Xia and Shang dynasties* Beijing, Commercial Press.

SONG, Z. 1994b. *The social life history of Xia and Shang dynasties,* Beijing, China Social Sciences Press.

SPEAR, A. H. 2018. *Black Chicago: The making of a Negro ghetto, 1890-1920*, University of Chicago Press.

STANEK, L. 2008. Lessons from Nanterre. *Log***,** 59-67.

STANEK, Ł. 2017. Collective luxury. *The Journal of Architecture,* 22**,** 478-487.

STATISTICAL BUREAU OF SHANXI PROVINCE, S. & NBS SURVEY OFFICE IN SHAANXI, N. 2009~2017. *Shanxi Statistical Yearbook* [Online]. Beijing: China Statistics Press. Available: http://tjj.shanxi.gov.cn/tjsj/tjnj/ [Accessed].

STATISTICS BUREAU OF PINGYAO COUNTY, S. 2019. *Statistical bulletin on national economic and social development of Pingyao county in 2018* [Online]. Pingyao: Pingyao County Government Website. Available: http://tj.pingyao.gov.cn/ [Accessed].

STEIL, J. P. & DELGADO, L. H. 2019. Limits of diversity: Jane Jacobs, the Just City, and anti-subordination. *Cities,* 91**,** 39-48.

STEINHARDT, N. S. 1986. Why were Chang'an and Beijing so different? *Journal of the Society of Architectural Historians,* 45**,** 339-357.

STEINHARDT, N. S. 1999. *Chinese imperial city planning*, University of Hawaii Press.

STENNING, A. 2005. Post-socialism and the changing geographies of the everyday in Poland. *Transactions of the institute of British Geographers,* 30**,** 113-127.

STERNBERG, E. 2000. An integrative theory of urban design. *Journal of the American Planning Association,* 66**,** 265-278.

SU, X. 2018. Reconstructing tradition: Heritage authentication and tourism-related commodification of the Ancient City of Pingyao. *Sustainability,* 10**,** 670.

SUN, M. 2010. *The production of art districts and urban transformation in Beijing,* University of Illinois at Chicago.

SUN, W. 2016. *Beijing will try to remove the walls of Renmin University of Chian and Beijing Institute of Technology* [Online]. Beijing: Beijing Evening News. Available: http://www.xinhuanet.com/politics/2016-07/27/c_129181005.htm [Accessed].

SUNG, H. & LEE, S. 2015. Residential built environment and walking activity: Empirical evidence of Jane Jacobs' urban vitality. *Transportation Research Part D: Transport and Environment,* 41**,** 318-329.

TA, N., CHAI, Y., ZHANG, Y. & SUN, D. 2017. Understanding job-housing relationship and commuting pattern in Chinese cities: Past, present and future. *Transportation Research Part D: Transport Environment,* 52**,** 562-573.

TANG, J. & DU, Z. 2008. *The archaeology of Lin' an in Southern Song,* Hangzhou, Hangzhou Publishing Group.

TAO, W. A city with many faces: urban development in pre-modern China (c. 3000 BC-AD 900). The Development of Urbanism from a Global Perspective, Proceedings of the Second World Archaeological Congress Intercongress, Mombasa, 1993 Mombasa.

TAO, Z. & YE, X. 1962. Survey report of ancient Wei city and ancient Yuwang city.. *Wenwu***,** 59-64.

TATSUHIKO, S. The population of capital Chang'an in Tang dynasty and the population distribution in the city. China Ancient Capital Research (12th Series) - Essay series of the 12th Annual Meeting of the Chinese Ancient Capital Society, 1994. Shanxi People's Publishing House.

TEAM 2 IN HENAN FROM INSTITUTE OF ARCHAEOLOGY IN CHINESE ACADEMY OF SOCIAL SCIENCES, T. 1999. Archeological Briefing of the small city in Shang city Yan' shi in Henan province. *Archaeology,* 107.

THE INSTITUTE OF ARCHAEOLOGY CHINESE ACADEMY OF SOCIAL SCIENCES, I. (ed.) 2002. *Chinese Archaeology and World Archaeology in The 20th Century,* Beijing: China Social Sciences Press.

THORP, R. L. 1991. Erlitou and the search for the Xia. *Early China,* 16**,** 1-38.

TOMBA, L. 2010. Gating urban spaces in China: inclusion, exclusion and government. *In:* BAGAEEN, S. & UDUKU, O. (eds.) *Gated communities: Social Sustainability in Contemporary and Historical Gated Developments.* Routledge.

UNDERHILL, A. P. 1994. Variation in settlements during the Longshan period of northern China. *Asian Perspectives*, 197-228.

VAN DE VLIERT, E., YANG, H., WANG, Y. & REN, X.-P. 2013. Climato-economic imprints on Chinese collectivism. *Journal of Cross-Cultural Psychology,* 44, 589-605.

VESSELINOV, E., CAZESSUS, M. & FALK, W. 2007. Gated communities and spatial inequality. *Journal of Urban Affairs,* 29, 109-127.

VON GLAHN, R. 2016. *An Economic History of China: From Antiquity to the Nineteenth Century*, Cambridge University Press.

WACQUANT, L. 1998. " A Black City Within the White": Revisiting America's Dark Ghetto. *Black Renaissance,* 2, 141.

WALDER, A. G. 1986. *Communist neo-traditionalism: Work and authority in Chinese industry*, Univ of California Press.

WAN, J. 2013. The Li, Fang, Lizheng and Fangzheng in city Changan of Tang dynasty. *Dongyue Forum,* 000, 79-84.

WANG, D. 2005. *History Outline of Chinese Urban Planning,* Nanjing, Southeast University Press in China.

WANG, D. & CHAI, Y. 2009. The jobs–housing relationship and commuting in Beijing, China: the legacy of Danwei. *Journal of Transport Geography,* 17, 30-38.

WANG, D. & ZHOU, M. 2017. The built environment and travel behavior in urban China: A literature review. *Transportation Research Part D: Transport,* 52, 574-585.

WANG, F. 2017. An analysis of the Teng ‘hua’ luo remains in Longshan Culture. *Jianghan archeology*, 54-62.

WANG, J. 2001. The plan for Beijing's new district made by Liang Sicheng and Chen Zhanxiang in the 1950s:a historic review. *urban Planning,* 15, 50-59.

WANG, J. 2003a. *City Memory of Beijing,* Beijing, Joint Publishing.

WANG, L. 2007. *History of Chinese Legal System (2nd Edition) (New Century Law Textbook),* Shanghai, Shanghai People's Publishing House.

WANG, S. 1999a. Exploring the population of Chang'an in Tang dynasty. Shi Nianhai(Editor in Chief) Chang'an and Guanzhong Plain in Han & Tang dynasties. *JOURNAL OF CHINESE HISTORICAL GEOGRAPHY*, 88-116.

WANG, S. 2009. PLANNINGTECHNIQUESOFCHANG’ANCITY IN SUI AND TANGDYNASTY. *CITY PLANNING REVIEW,* 33, 55-72.

WANG, S.-Y. 2008. *Tradition, memory and the culture of place: continuity and change in the ancient city of Pingyao, China*, University of Colorado at Denver.

WANG, S.-Y. 2012. From a living city to a World Heritage City: authorised heritage conservation and development and its impact on the local community. *International Development Planning Review,* 34**,** 1-17.

WANG, T., MARUYAMA, A. & KIKUCHI, M. 2000. Rural-urban migration and labour markets in China: a case study in a northeastern province. *The Developing Economies,* 38**,** 80-104.

WANG, X. 1999b. *The capital city Xianyang of Qin dynasty,* Xian, Shanxi People's Publishing House.

WANG, X. 2003b. The Evolution of China's Rural Control System after the Revolution of 1911 (Xinhai revolution): The Evolution of the Rural System and the Revival of the Baojia System in the Early Period of the Republic of China. *Social science research,* 6**,** i11-115.

WANG, X.-R., HUI, E. C.-M., CHOGUILL, C. & JIA, S.-H. 2015. The new urbanization policy in China: Which way forward? *Habitat International,* 47**,** 279-284.

WEBER, M. 2015. Bureaucracy. *Working in America.* Routledge.

WEKERLE, G. 2000. From Eyes on the Street to Safe Cities [Speaking of Places]. *Places,* 13.

WEN, J. 1935. *The Bao Jia system in China,* Shanghai, Commercial Press.

WEN, Q. 2012. *Intensive Reading of "Zuo Zhuan · The 2nd Year of Zhaogong",* Shanghai, Shanghai Ancient Books Publishing House.

WHYTE, M. K. 1973. Bureaucracy and modernization in China: The Maoist critique. *American Sociological Review***,** 149-163.

WHYTE, M. K. & PARISH, W. L. 1985. *Urban life in contemporary China*, University of Chicago Press.

WHYTE, W. H. 1980. The social life of small urban spaces.

WIRTH, L. J. A. J. O. S. 1938. Urbanism as a Way of Life. 44**,** 1-24.

WOMACK, B. 1991. An Exchange of Views about Basic Chinese Social Organization Review Essay: Transfigured Community: Neo-Traditionalism and Work Unit Socialism in China. *The China Quarterly,* 126**,** 313-332.

WU, F. 2002a. China's changing urban governance in the transition towards a more market-oriented economy. *Urban Studies,* 39**,** 1071-1093.

WU, F. 2005. Rediscovering the 'gate' under market transition: from work-unit compounds to commodity housing enclaves. *Housing Studies,* 20, 235-254.

WU, F. 2011. Retreat from a totalitarian society: China's urbanism in the making. *The new Blackwell companion to the city*, 701-712.

WU, F. & WEBBER, K. 2004. The rise of "foreign gated communities" in Beijing: Between economic globalization and local institutions. *Cities,* 21, 203-213.

WU, H. X. 1994. Rural to urban migration in the People's Republic of China. *The China Quarterly,* 139, 669-698.

WU, J. 2019. Remember history and create the future together - 70 years of the new China economy. *Caixin Weekly.* Beijing: Chinese Cultural and Historical Press.

WU, J., TA, N., SONG, Y., LIN, J. & CHAI, Y. 2018. Urban form breeds neighbourhood vibrancy: A case study using a GPS-based activity survey in suburban Beijing. *Cities,* 74, 100-108.

WU, J., YU, D., FU, L. & AL., E. 2008. *The history of Beijing's development,* Beijing, Yanshan Publishing House.

WU, Q., ZHANG, M. & YANG, D. 2015. Jobs-housing balance: the right ratio for the right place. *Recent Developments in Chinese Urban Planning.* Springer.

WU, Q., ZHAO, Z., LIU, L., GRANGER, D. E., WANG, H., COHEN, D. J., WU, X., YE, M., BAR-YOSEF, O. & LU, B. 2016. Outburst flood at 1920 BCE supports historicity of China's Great Flood and the Xia dynasty. *Science,* 353, 579-582.

WU, W. 2004a. Sources of migrant housing disadvantage in urban China. *Environment planning A,* 36, 1285-1304.

WU, X. 2002b. Work units and income inequality: the effect of market transition in urban China. *Social forces,* 80, 1069-1099.

WU, X. 2013. Redrawing the boundaries: Work units and social stratification in urban China. *Chinese Sociological Review,* 45, 6-28.

WU, Z. (ed.) 2003. *Research on the Political System of the Tang Dynasty,* Beijing: Shanghai Lexicographical Publishing House.

WU, Z. (ed.) 2004b. *The Research on the Political System of Ancient Chinese Bureaucrats,* Beijing: Beijing University Press.

WU, Z. & YE, Z. 2016. Research on urban spatial structure based on Baidu heat map: A case study on the central city of Shanghai. *City Planning Review,* 40, 33-40.

XIA, C., YEH, A. G.-O. & ZHANG, A. 2020. Analyzing spatial relationships between urban land use intensity and urban vitality at street block level: A case study of five Chinese megacities. *Landscape and Urban Planning,* 193**,** 103669.

XIE, Y. 2013. *A research on the Fungshui arrangement of Chinese palace*, Hualing Publishing House.

XINHUA NEWS AGENCY, X. 2016. *Suggestions on Further Strengthening the management of urban planning and construction by the Central Committee of the Communist Party of China* [Online]. Beijing: XNA. Available: http://www.gov.cn/zhengce/2016-02/21/content_5044367.htm [Accessed].

XIONG, A. 1983. *History of higher education in China,* Chongqing, Chongqing Publishing House.

XU, G. (ed.) 2002. *A Study of the Layout of the ancient city Yenancheng in the Eastern Wei and Northern Qi Dynasties,* Beijing: Cultural relics publishing house.

XU, H. 2000. *An Archaeological Research on Cities in Pre-Qin Period,* Beijing, Beijing Yanshan Publishing House.

XU, H. 2016. *Metropolis without city walls: an exploration of ancient Chinese capital cities with a dynamic perspective,* Beijing, Joint Publishing.

XU, H. 2017a. *The Tradition of Non-fortified Primary Capitals in Early China: the interpretation of ancient Chinese capitals with a dynamic perspective,* Beijing, SDX Joint Publishing Company.

XU, H. 2018. Erlitou: the origin of the tradition of non-fortified primary capitals in early China. *Archaeological Research in Asia,* 14**,** 71-79.

XU, H. & ZHAO, H. 2004. The survey and excacation of the palace city and its peripheral roads in Yan' shi, Henan provience. *Archaeology***,** 3-13.

XU, L. 2004. *The Mystery of the Dead City: The Ancient Chinese Capital Archaeology*, Sichuan People's Publishing House.

XU, M. 2009a. *Gated communities in China: urban design concerns*, Cardiff University (United Kingdom).

XU, M. & YANG, Z. 2009. Design history of China's gated cities and neighbourhoods: Prototype and evolution. *Urban Design International,* 14**,** 99-117.

XU, S. 2017b. From Chengfu to Chengguo: an Observation on the Morphological Evolution of Capital City in the Case of the Eastern Zhou Dynasty. *Archaeology***,** 45-50.

XU, W. 2009b. Chang'an City of Han Dynasty: inheritatance and innovations based on Qin capital Xian' yang. *Tangdu Academic Journal*, 1-5.

XU, Y. 2019a. Historical Review of Beijing's Air Pollution Control in the 1970s and 1980s. HPRC (The History of the people' s Republic of China).

XU, Y. 2019b. Historical Review of Beijing's Air Pollution Control in the 1970s and 1980s: a focus on Smoke and Dust Removal. *Contemporary China History Studies*.

XUE, F. 2010. *The evolution of Chinese cities and their civilizations,* Beijing, World Publishing Corporation.

YAN, C. (ed.) 1987. *The imperial palaces of ancient capital cities in China.* : The forbidden city press.

YAN, G. 2007. A Review of the Studies on Land Systems in Qin and Han in the Past 50 Years. *Chinese history research dynamics*, 9-18.

YANG, C. & WU, C. 1996. *Ten-Year Reform of Land Use System in China,* Beijing, China, Zhong Guo Da Di Publisher.

YANG, K. 1993. *A research on the institutional history of ancient capital cities in China.,* Shanghai, Shanghai ancient books publishing house.

YANG, S. 1992. *The economic history of Shang dynasty.,* Guiyang, Guizhou people's press.

YAO, Q. & WEI, W. 2012. Gated community: The past and present in China. *World Academy of Science, Engineering Technology Analysis & Strategic Management,* 7, 691-693.

YE, Z., CHEN, Y. & ZHANG, L. 2017. The analysis of space use around Shanghai metro stations using dynamic data from mobile applications. *Transportation research procedia,* 25, 3147-3160.

YIN, S. & HUANG, C. 2008. Comparative study of drought and flood in capitals Chang'an / Luoyang in theWest and Eastern Han Dynasties. *JOURNAL OF NATURAL D ISASTERS,* 17.

YIN, Y., LIU, Z., DUNFORD, M. & LIU, W. 2015. The 798 Art District: Multi-scalar drivers of land use succession and industrial restructuring in Beijing. *Habitat international,* 46, 147-155.

YUAN, F., GAO, J. & WU, J. 2016. Nanjing-an ancient city rising in transitional China. *Cities,* 50, 82-92.

YUE, Y., ZHUANG, Y., YEH, A. G., XIE, J.-Y., MA, C.-L. & LI, Q.-Q. 2017. Measurements of POI-based mixed use and their relationships with neighbourhood vibrancy. *International Journal of Geographical Information Science,* 31, 658-675.

ZHAI, W. 2005. A Historical Investigation of the Beijing City Wall after the Founding of the People's Republic. *Beijing Social Science*, 62-71.

ZHANG, C. & CHAI, Y. 2014. Un-gated and integrated work unit communities in post-socialist urban China: a case study from Beijing. *Habitat International,* 43, 79-89.

ZHANG, C., CHAI, Y. & CHEN, L. 2009a. The Evolution from Danwei Community to Citizen Community: Case Study of Tongrentang in Beijing. *Urban Planning International,* 24, 33-36.

ZHANG, F. 2004. *Research on the evolution, problem and countermeasure of the unit compound in transformation period: typical cases in Beijing.* Master of Engineering, Southeast University.

ZHANG, G. 2000. *Research on capital system in Xia and Shang dynasties,* Zhengzhou, Henan People's Publishing House.

ZHANG, G. 2009a. Rural Grassroots Organization and Its Evolution in the Tang Dynasty. *Acta Scientiarum Naturalium Universitatis Pekinesis*, 112-126.

ZHANG, K. H. & SONG, S. 2003. Rural–urban migration and urbanization in China: Evidence from time-series and cross-section analyses. *China Economic Review,* 14, 386-400.

ZHANG, L. 2005. "Migrant enclaves and impacts of redevelopment policy in Chinese cities." Restructuring the Chinese city: Changing society, economy space. 218-233.

ZHANG, M. & ZHAO, P. 2017. The impact of land-use mix on residents' travel energy consumption: New evidence from Beijing. *Transportation Research Part D: Transport Environment,* 57, 224-236.

ZHANG, T. 2008. Re-exploring the population issue of Capital Chang'an in the Tang Dynasty: a comment on the population study of Tang Chang'an in the past 15 years. *Tangdu Journal,* 24, 11-14.

ZHANG, T. 2018. An exploring of the population of Youzhou city ruled by military governor during the Tang dynasty (763-907). *Researches in Chinese Economic History,* 135(01), 15-31.

ZHANG, W. & DENG, F. 2003. Information, Incentive and Joint Responsibility: A Legal and Economic Interpretation of Lian Zuo and Bao jia Systems in Ancient China. *Social Sciences In China,* 3.

ZHANG, X. Q. 1997. Urban land reform in China. *Land use policy,* 14**,** 187-199.

ZHANG, X. Q. 2002. Governing housing in China: State, market and work units. *Journal of Housing the Built Environment,* 17**,** 7-20.

ZHANG, Y. 2003. *The history of Chinese ancient cities,* Tianjin, Baihua Literature and Art Publishing House.

ZHANG, Y. 2009b. *The history of Chinese cities*, China Friendship Publishing Company.

ZHANG, Y., CHAI, Y. & ZHOU, Q. 2009b. The Spatiality and Spatial Changes of Danwei Compound in Chinese Cities: Case Study of Beijing No.2 Textile Factory. *Urban Planning International* 24**,** 20-27.

ZHANG, Y., CHAI, Y.-W. & ZHOU, Q.-J. 2009c. The Spatiality and Spatial Changes of Danwei Compound in Chinese Cities: Case Study of Beijing No.2 Textile Factory. *Urban Planning International,* 24**,** 20-27.

ZHAO, C. 1987. Supplementary Examination of Luoyang City in Tang Dynasty. *Archaeology,* 9.

ZHAO, G. 1994. The population of Lin' an in Southern Song. *Journal of Chinese Historical Geography***,** 117-126.

ZHAO, G. 2006a. *Analects of Chinese urban development history,* Beijing, New Star Press.

ZHAO, H. 2006b. Preliminary Analysis of Archaeological Findings in Palace area of Erlitou. *The Archaeology of Three Dynasties***,** p159-169.

ZHAO, M., BAO, G. & HOU, L. 1998. *Land Use System Reform and Urban and Rural Development,* Shanghai, Tongji University Press.

ZHAO, P., LÜ, B. & WOLTJER, J. 2009. Conflicts in urban fringe in the transformation era: An examination of performance of the metropolitan growth management in Beijing. *Habitat International,* 33**,** 347-356.

ZHAO, S. & SHA, L. 2016. *The government of Beijing denied to open up those universities by removing their walls* [Online]. Beijing: Beijing News, BN. Available: http://education.news.cn/2016-07/28/c_129184286.htm [Accessed].

ZHAO, S. & ZHOU, S. An introduction of the socio-spatial structure of Beijing in Ming and Qing dynasties. *History Monthly***,** 112-119.

ZHAO, X. 2006c. *The problems of the micro land use and transportation development: from the working unit courtyard ideology to the developer' s community* Dalian University of Technology.

ZHAO, Y. 2002. Earnings differentials between state and non-state enterprises in urban China. *Pacific Economic Review,* 7**,** 181-197.

ZHOU, C. 2001. *The study of citis in Han dynasty,* Beijing, People' s Publishing House.

ZHOU, J. A study on the population of Dadu of Yuan dynasty. Selected Works of the Chinese Mongolian History Society, 1981.

ZHOU, X. 2000. Economic transformation and income inequality in urban China: evidence from panel data. *American Journal of Sociology,* 105**,** 1135-1174.

ZHOU, Y. 2018. On the Interaction between Monastery Layout and Urban Planning of Luoyang during the Reigns of Xuanwu and Xiaoming in the Northern Wei Dynasty Governance of the Western Regions. *Social Science Front,* 10**,** 143-155.

ZHU, K. 1972. A Preliminary Study of Climate Change in China in the Past Five Thousand Years. *Chinese science***,** 15-38.

ZHU, S. & HU, L. 1998. A preliminary study of changes of climate in Guanzhong area in historical period. *Quaternary Research,* 18**,** 1-11.

ZWICKY, F. 1969. Discovery, invention, research through the morphological approach.