A Comparative Study of Supergrid and Superblock Urban Structure in China and Japan

Rethinking the Chinese Superblocks: Learning from Japanese Experience

By

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Declaration

This is to certify that to the best of my knowledge, the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged. This thesis has not been submitted for any degree or other purposes. All figures without acknowledgment or noted with ‘by author’ are made by the researcher of this study.

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Date: August 28th, 2017
Abstract

The Supergrid and Superblock together constitute a grid-and-cell urban structure that is especially evident in China and Japan (where its origins are ancient). The Supergrid is a large-scale net of wide roads that defines a series of cells or Superblocks, each containing a network of narrower streets. While this structure is common in both countries, there are no detailed comparative studies between the two. Existing literature presents a diverse field of study, but an understanding of the structures and their functioning remains in its infancy, and the little study that has occurred is mostly from social and planning perspectives. Morphological study is particularly sparse and this reveals a gap in current knowledge. This research is an urban design study that investigates the structure and associated functioning through the lens of physical morphology, and so fills a blank.

The thesis places the structures in their cultural contexts and examines them against a group of theories developed since the 1960s. Those theories are presented collectively as ‘Interconnection Theory’, which focuses on the interrelationships between urban form and function and stress the importance of a well-structured network of streets as a prerequisite for convenient living and synergetic relationships between functions. Several qualitative and quantitative methods (including Space Syntax) are taken or developed from the source theories to explore levels of integration, connection, and interaction in four selected Superblocks – two from China (Xi’an and Nanjing) and two from Japan (Kyoto and Osaka). These investigate form-function interrelationships within the four Superblocks, and between the Superblocks and their wider Supergrids, with particular emphasis on relationships between street networks, and the distribution of functions/activities.

Further, design principles are extracted from the findings and model design approaches suggested for the generation of more effective Superblock structures as part of the conclusion. These principles are tested through application to the two Chinese case study Superblocks, where modifications to the street structures are proposed to ameliorate current functional weaknesses in the addendum.
A number of findings can be concluded from this research, which is an important contribution to our knowledge of both urban structure and spatial culture. These primary findings include:

i) Chinese and Japanese cities have similar Supergrid systems that provide multidirectional global movement across extensive urban areas but there are large disparities of morphology within Superblocks where different street structures and functional patterns are revealed.

ii) The ‘Supergrid and Superblock structure’ is shown to be strongly rooted in Eastern Areal culture with (Chinese) ‘wall-oriented’ and (Japanese) ‘floor-oriented’ spatial conceptions providing an explanation for the different forms and patterns of function within the Superblocks. While both structures demonstrate clear structural and functional advantages and disadvantages, the Japanese Superblocks reveal some important structural merits that can be used to improve activity distribution and movement in Chinese Superblocks.

iii) These differing internal structures of connection within the Superblocks have a deterministic impact on the spatial distribution of human activities and uses. Clear but divergent patterns are displayed in the four Superblocks with strong interrelationships between the type of street network and the nature of the distribution of activities in the two Japanese cases but less distinct ones in the Chinese Superblocks. This is traced to the influence of a wall-and-gate structure that is characteristic of China but absent in Japan.

iv) Some uses and activities tend to occur in particular locations within the street structures of the four case study sites that show distinct patterns of distribution.

v) Findings from the four site investigations stress the importance of high levels of integration, connection and interaction in urban structure for effective functioning under different cultural contexts, thus reinforcing the validity of interconnection theory principles.
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Chapter One: Introduction
1.1. Key Definitions:

This first section is to clarify some key definitions for a better understanding the thesis.

**Urban Form:**

It usually refers to the static physical configuration and spatial arrangement of the major components (e.g. streets, blocks, plots and buildings) that construct and shape the urban tissues (Conzen 1960, Brindle & Brunton 1999, p.2, Oliveira 2016, Introduction p.2)

**Urban Function:**

It refers to the socio-functional uses or contents of the physical form. This can include activities in buildings and spaces, and different modes of travel as movements along streets.

**Urban Morphology:**

It usually refers to the study of urban form (Cowan 2005 and Oliveira 2016), and ‘the study of change in the physical form and shape of settlements over time – focuses on patterns and processes of growth and change’ (Carmona 2003, p77).

**Urban Structure:**

It refers to the way in which parts of a city relate to each other dynamically and usually represents itself as a certain urban pattern, which is a physical form of the connections that are created by the use and travel of its inhabitants between different parts of a city (Based on Brindle & Brunton 1999, p.2 and Hemmens 1967, p.31).
‘Supergrid and Superblock’ Urban Structure:

This is a net-and-cell structure: a Supergrid net (which may be an uniform or deformed grid) of wide cross-city or arterial roads at the city scale forming a series of Superblock cells, each containing sets of street blocks and networks of streets at a local scale (see Figure 1.1). The Supergrid and Superblocks are interdependent and mutually supportive parts of a single urban system.

Supergrid:

The Supergrid is an urban structural network of wide roads (ranging usually from 25m to 50m in width) that forms a multi-directional net over large areas of a city: the roads may therefore be termed ‘global’ (see Figure 1.2).

Superblock:

The Superblock is an area or cell of approximately 1km² (though it may be larger or smaller) that is defined and bound by a network wide global roads of a Supergrid and made up of a network of narrower streets (see Figure 1.3).

Figure 1.1 - Scales of urban streets and their relationship between each other (by author)
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1.2. The Eastern City Morphology: A Statement of the Research Intention

With long and rich histories, ‘China and Japan can be classified together as highly developed pre-modern societies (Rozman 1973, p.6)’. Cities in the two countries have been flourishing for thousands of years and designed within strong cultural predispositions that are largely different from the West’s. China and Japan share many aspects of culture, and they both have the experiences of urban development that are based on one of the most classical and ideal planning paradigms of cities that has also influenced city form in other East Asian countries: a Supergrid and Superblock structure. While the origin of this structure can be traced back to ancient China, new forms are sculpted as the structure has been evolved through various transformations and strong western influence in modern times (see Figure 1.4).

Interestingly, a ‘Supergrid and Superblock structure’ can still be found in the more urbanized areas of many modern Chinese and Japanese cities, constituted by a network of wide roads at city scale as a Supergrid that defines a series of cells as Superblocks, each containing a network of narrower streets. This triggers an intriguing but peculiar condition of Chinese and Japanese cities as they both have a ‘Supergrid and Superblock structure’ but divergent urban morphologies. With a desire to reveal this mystery, this study investigates these specific urban structures by asking a basic question: what are the similarities and differences between these structures in the cities of the two countries that have created such dissimilar urban form?
It is important to note that while Superblocks can be commonly found in both Eastern and Western cities, they are more often embedded in a radial structure in the West (Milton Keynes is a well-known exception), but as an incorporated part of a multi-directional grid structure in Eastern cities. In other words, the East and West have fundamentally two different types of urban structure although they may present a similar urban form. This strong correlation between culture and spatial conception that contributes to the design and formation of urban structure has been widely discussed in existing literature and is further elaborated in Chapter 2.

However, cities are not only places where culture manifests itself on both micro and macro magnitudes, they are also places where the fundamental functions of a city, trade and exchange, take place. In other words, they are not only products as physical forms with socio-cultural codes, but also the producers of efficient economic performance through the facilitation of free-willed human movement and activities (Hillier 2002). A group of theories, which has emerged from the West since the 1960s concerning the quality of modern cities and the interrelationship between urban structure and functional use, raises the discussion of a good structure that can effectively support economic performance and general vitality. Those theories not only provide the theoretical framework for this study as discussed in Chapter 3, but also inspire a system of methods as explained in Chapter 4 that are used to investigate this structure in order to understand how it affects, or is counter-affected by the distribution of movement and activities? In other words, what are the interrelationships between the form and function of the structure in the cities of the two countries?

With such double-folded understanding of city structure in mind, the Supergrid and Superblock structure in China and Japan presents two divergent paths through various transformation-s. Today this structure in China appears to display certain disadvantages, while it seems to offer certain advantages in terms of the generation and facilitation of movement and activities in the Japanese cities.
China inherits the Supergrid and Superblock structure as the basic city skeleton from the Tang Dynasty (6AD) (Xu 2000). Through a continuous development in history, the Superblock structure was transformed from a closed to a relatively open and to a closed system in relation to the Supergrid. As a result, the modern Chinese city structure seems to show an inability to support many modern functions of a city because the cultural influence of certain morphologies. The Superblock structure in China tends to fragment cities because of the disconnections between street networks within Superblocks and the citywide arterial road networks (Xu and Yang 2009b, Zhao 2008 and Nieminen 2012). This connection problem has led to longer walking distances, traffic congestion and the uneven distribution of activities that are functional problems caused by the urban structure. These issues further create a series of social, economic and environmental problems in cities: air pollution, traffic congestion, longer commuting times and single use of land and zoning, etc. (Guo 2009). The traditional mix-functioned and walkable cities are disappearing; the traces of Chinese culture and architecture are being lost; the fragmentation of cities is becoming a much more severe phenomenon along with many urban diseases (Ding 2009).

In comparison, although heavily influenced by China, the Supergrid and Superblock structure in Japan was adapted and transformed from a closed and semi-closed system to an open system according to its own culture. Correspondingly, this structure has been configured to achieve good local and citywide integration and incorporate public transport (Shelton 2012). The traditional Japanese spatial structure is incorporated with modern revolutionary changes in cities to create a diverse, vibrant and convenient urban environment (Ando 2003, Watanabe 1985, Jinnai 1994, Fujita and Hill 1997, Hohn 2000, Hein 2008 and Sorensen 2011). This resonates with the New Urbanism’s idea of creating mixed land use and good connections in city design. Important characteristics of vibrant cities, culture and traditional aspects of people’s lives are preserved (Ashihara 1989). Japanese cities show their own distinctive characteristics and ‘personalities’ with far fewer problems. Some contemporary observers even think of modern Japanese cities as a model for the future, an inspiration for urban planning (Mohr 2007) and a valuable lesson for developing countries on the ways to modernize their cities. (Sorensen 2011)
With such messages from existing studies, it is easy to understand that structures of cities are the physical manifestation of underlying socio-cultural and economic forces that allow human activities and movement to take place. While a good city structure can both accommodate local culture that contains the soul of a city, it can also assist the generation and facilitation of socio-economic movements and activities. The Supergrid and Superblock structures in Chinese and Japanese cities are rooted in Eastern culture. Associated with Chinese and Japanese cultures, they present also divergent characteristics that have the power of assisting or deterring the functional use of cities. In other words, this thesis argues that these strong culture-structure correlations explain the similarities and differences of urban morphology and functional performance of the Chinese and Japanese versions of the Supergrid and Superblock structure.

Nevertheless, existing scholarship about this Supergrid and Superblock structure in cities of the two countries is limited. In general, two lines of inquiry about this structure can be found: 1) the exploration of socio-cultural influences on the design of spatial form as historical and social studies; and 2) the investigation of the relationship between physical form and human behaviour as modern urban studies. The issue with the existing literature is that they offer very limited understanding and discussion of the intricacies between the two resulting in two separate compartments of academic urban studies.

There are three lines of inquiry about this structure in China. Firstly, many existing studies recognize the ‘gated community’ as the major morphology of Chinese cities, and they often confuse and equate it with the concept of Superblock. Secondly, most studies do not concern the Supergrid and Superblocks as one structural system. When they do, these studies do not explore the structure in a systematic, detailed and analytical way that relates to the functional use under a cultural discourse. Or, more often, studies are more concerned with the functional use of cities from socio-cultural and political perspectives. Thirdly, the clearest understanding of the structure from a physical perspective comes from historical studies about the ancient structure. Very few studies discuss the modern Supergrid and Superblock structure with clarity and recognize its decisive role in shaping and affecting the functional use of cities, except some more
recent studies that investigate the transportation system without recognizing it as a super grid-and-cell city structure.

Similarly, while studies about Japanese cities are abundant, existing literature of this structure is even rarer. The only enlightening discussion is made by Shelton (2012) from the detailed study of a Superblock and limited study of the Supergrid in Nagoya. Other studies of Japanese cities are either about the physical morphology without recognizing the Superblock and Supergrid; or focused on the functional aspects of cities from social, cultural and political layers, which are the most favored discussion. The Superblock structure in Japan bears a different understanding in some contexts: they are often understood as a huge building block instead of a system of urban structure – from an Architectural rather than urban design perspective. The only clear recognition of the structure is likewise found in many historical studies about the ancient structure rather than the modern version.

More importantly, there is no framing of the question in a comparative mindset that sees the similarities and differences of the modern structure from two culturally related countries. When the study of the structure does exist, they mostly compare the structure of ancient Chinese and Japanese cities (e.g. Chang’an and Heian-kyo). Altogether, worthwhile research in this area of urban studies is patchy, and it implies a clear blank area in comparing the Supergrid and Superblock structure in modern cities.

With such a background and research gap as discussed above, this proposed research aims to investigate the interrelationship between the form and function of the Supergrid and Superblock structure in contemporary Chinese and Japanese cities in order to understand the structural similarities and differences between the two countries. This research overcomes the problem of existing studies by bridging cultural studies and modern urban design theories together to understand cities as ‘organized complexities’.

The comparative case study is the major research method, and it contains six stages of interrogation. While comparison is mainly between China and Japan, Xi’an and Kyoto are paired as one group to indicate Superblocks located in the middle part of a
Supergrid; Nanjing and Osaka are paired as the second group to demonstrate Superblocks located at the edge of a Supergrid. An important component of this investigation is morphological mapping, which is used to study and document the selected Superblocks in order to understand their urban structures. This is expected to discover the relative conditions, advantages and disadvantages of the structure in Chinese and Japanese cities. This comparison also leads to a number of design principles behind effective spatial organization of Superblocks for the improvement of Chinese cities. Following from the main findings, this thesis proposes design principles for improving the structure in Chinese cities and formulates a potential model: these are further applied with the experimental modifications to the two Chinese case study sites.

Based on the theories and methodology as constructed by this thesis, the investigation of the four case study sites reveals some fundamental and fascinating discoveries. These can be summarized in three major aspects.

1) Culture has a profound influence on the physical morphologies of both the Chinese and Japanese cities. There is a similar ‘Areal thinking’ embedded in their cultures, and it correlates with the use of a multi-directional Supergrid road system. Respectively, the ‘wall’ and ‘floor’ oriented spatial conceptions are responsible for differences in Superblock structures between the cities of the two countries. The Chinese cities contain an extensive ‘wall and gate’ structure accompanying with a limited street network; while the Japanese cities have an extensive street structure that contains two-dimensional and ‘Oku-like’ spatial characteristics.

2) There are identifiable street-activity relationships in the four study sites. In Chinese Superblocks, the location of the gates of compounds decides where most movements and activities can take place because of existence of a ‘wall and gate’ structure. Such structures create a problem of over-concentration of functions in limited areas in Chinese Superblocks. In comparison, in Japanese Superblocks Glocal streets in a pure street network play the key role in distributing most activities and provide the crucial linkage between Global and local movements. This generates a well-distributed pattern of activities across Superblocks in Japan.
3) Japanese Superblocks provide inspiration and guidance for improvements to Chinese Superblock structures. Perhaps the most important potential modification that can be made is the construction of well-connected and integrated Glocal streets while still respecting the wall structure, which is a manifestation and valued item of the Chinese culture.

A Note on Research Theory and Method:

In the use of analytical theories and methods, one question that should be raised is this: will the employment of Western ideas and methods for a study of Chinese and Japanese cities become a paradox in itself?

There are three reasons that actually support the use of the Western theories.

The first reason is that both China and Japan have been strongly influenced by the West and modern urban design and planning ideas since the 19th century: these have been widely applied and practiced in the fields (Chang 1982 & Lu 2006). It is arguably that both China and Japan did not accept the Western ideas fully as they are molded to fit Chinese and Japanese cultures in acceptable forms and principles (Lu 2006, Mohr 2008 and Sorensen 2001). It is also undeniable that most Chinese and Japanese major cities are modern cities, both physically, functionally and even socially. It is possible that a ‘non-Western urban tradition, which had modernized while remaining free of European cultural influence – unfortunately’ does not exist (Smith 1979, p.49).

The second reason is that there are no systematic theories about understanding of modern Chinese or Japanese cities that are based purely on Chinese and Japanese culture. The complication of Eastern cities is that they are not simply formed with pure bloodline of the influence of their traditional culture and ideology, but are heavily influenced by and have collided with ideas from the West. In other words, they are hybrids of Eastern and Western ideas with a ‘discourse (that is) polarized between the East and the West on the (one) hand, and between tradition and modernity on the other’ (Schulz 1999, p. 28). Therefore, simply applying Chinese or Japanese planning theories (even if they exist) is not sufficient for studying modern cities. It follows that using
Western theories to understand the modern cities is not a contradiction. These are appropriate and ‘helpful tools for analyzing urban matters in other cultures if one keeps their limits in mind’ (ibid.). More importantly, the essence of the group of studies that is used as the theoretical foundation of this research regards urban structure as a semi-lattice or urban web rather than a man-made tree or tributary system. This strongly coincides with the philosophical positions of the Eastern culture and Areal thinking in city design and planning, as discussed in Chapter 4.

The third reason is also mentioned in Zhu’s study, who met with the same issue: in this mix-and-matched globalized world, ideas and methods can be tested across cultural boundaries as experiments with the respect to cultural differences (Zhu 2004, p.9-10). Tentative conclusions from the cross-cultural experiments are open to debate, which might even lead to further studies and possible intellectual development. With some caution, this research regards the dialogues across cultures, ideas and theories as positive and constructive attempt to generate new questions and inspirations that may help China and other places in their future urban development.

1.3. Research Aims, Purposes and Questions

This study focuses on the Superblock structure in the Supergrid network as part of an Eastern city structure under Chinese and Japanese culture framework. The aim of this research is to investigate the nature of this structure in Chinese and Japanese cities and extract underlying design principles through the exploration of the interrelationships between their form/structure and function (activity/movement). Through the understanding of the two types of urban morphologies, this study also proposes a potential model to improve the structure in Chinese cities as part of the conclusion. The following expands with more details:
• To investigate the Supergrid and Superblock phenomenon as an expression of culture – one that is rooted in Eastern spatial practice
• To explore the evolution of the Superblocks in China and Japan as background to the present condition
• To assemble the relevant theories as an interrelated body of thought that will form an integrated conceptual base for understanding the structure-function interplay
• To use this theoretical basis to both gather and develop new techniques for the mapping and analysis of the Supergrid-Superblock structure
• To investigate the nature of the Superblocks in China and Japan and their 'potential' values and/or 'problematic' characteristics
• To explore the relevant Chinese and Japanese approaches to spatial design
• To extract organizational and design principles concerning Supergrid-Superblock structure and functions for the potential improvement of (particularly Chinese) Superblocks
• To test these principles through application to a sample Superblock site in China: this experimental or research design also contribute to the research conclusions

With such research purpose, the central research question of this study is:

**What are the similarities and differences of the Supergrid and Superblock in Chinese and Japanese cities?**

Four sub-questions are also raised to further decode the central questions:

1. How does culture contribute to the structural similarities and differences?
2. How does the physical structure affect the functional use of urban space?
3. What are the structural advantages and disadvantages and design principles?
4. What are the implications of this study?

Correspondingly, a research framework as indicated in Figure 1.5 is developed to unravel those research questions in three groups.
1.4. Research Framework and Structure: Explanations of Chapters

Like any studies that try to unravel a story about cities, it is complex and intertwined with different sub-stories and plots. Likewise, this research narrates the story from cultural to physical to functional understanding of this specific city structure. This thesis has three major parts with seven chapters and an addendum. The first part introduces this thesis and research purposes, discusses existing literature of the cultural understanding of physical structure, and extracts the theoretical basis from a group of related ideas from modern urban design studies. This provides an understanding of the structure from a contemporary urban design perspective under the Eastern cultural framework. The second part constructs a methodology that is derived from the theories and studies in the first part, analyses key data and mapping about the interrelationship between the form and function of the Supergrid and Superblock structure, and reveals the results from four case study Superblocks. The third part includes the conclusion of the major findings from part one and two, and further, sheds light on how China can improve its city structure by learning from the Japanese examples. The following explains each part in more detail.
PART I: Introduction, Literature Review and Methodology:

Chapter One is a general introduction that provides an overview of the research purpose, background and structure of this thesis. It explains key terminologies, research concepts, limitations and objectives of the research.

Chapter Two explores the different cultural backgrounds that influence the formation of the Supergrid and Superblock structure. It reveals a similar multi-directional grid at the city scale that is influenced by the same Areal thinking, multi-dimensional and multi-directional conception of space; and different structures within Superblock cells that are created by ‘wall and floor’ oriented spatial conceptions. It explains how those differences have created different Superblock structures in the two countries under the same Eastern cultural ideology.

Chapter Three explains the theoretical framework of this thesis. It discusses a group of modern urban design theories that considers the interplay between built environment, movement and activity in cities, which will set up the theoretical and methodological backcloth of this research and inspire a number of morphological mapping techniques for this study. Further, a number of empirical studies that have analyzed the relationships between urban form and movement/travel are used as a secondary support for a quantitative understanding the issues.

PART II: Method, Case Studies and Preliminary Findings:

Chapter Four expands and develops the theories into a system of mapping and analysis to form the system of method for this study. Those methods are inspired by and developed from the theoretical basis as discussed in Chapter 3, and are further used in the collection of data, field investigation, creating maps and data analysis.

Chapter Five and Six demonstrate the results and findings of the field investigations of the four sites: each is from Xi’an and Nanjing, Kyoto and Osaka. They are diagrammed and mapped based on the methods discussed in Chapter 4. Each chapter constitutes three parts: introduction, the investigations of two sites from the cities in each country,
and a summary that compares of the findings of the two sites and related design principles. Further, each case study includes four major sections: 1) the cultural influence and historical transformation of each study site; 2) the general morphology of each site; 3) a detailed study of the interrelationship between the street network and functional activities through integration, connection and interaction with maps and data; and 4) a discussion of the findings of each case study.

PART III: Conclusion and Design Addendum:

Chapter Seven is the conclusion that draws together the whole thesis from four aspects. 1) the Importance of Cultural Influences and Special Cultural Forms in Chinese and Japanese culture; 2) similarities and differences of Chinese and Japanese Supergrid and Superblock Structures; 3) the design principles of the Supergrid and Superblock Structure in Chinese and Japanese cities; 4) a proposed potential model for China to improve the structure in Chinese cities.

Following Chapter Seven, there is an Addendum, which presents experimental modifications of the two Chinese case study Superblocks. They apply the design principles as discussed in the proposed model in Chapter Seven, and provide possible solutions for improving China's urban functional problems in a practical way.

Figure 1.6 – Chapter explanation diagram (by author)
1.5. The Scope and Significance of the Study

‘The unprecedented speed and scale of urban development today – particularly in places like China – is resulting in ever more complex relationships between architecture and city form’ (Maki 2008, p. 4). The Superblock development as a ‘meta-typology has been a vehicle for China’s urbanization’ (Monson 2008, p.3). This urban structure is such a key to understanding Chinese cities that should not be ignored anymore. How it performs and serves China will be unforeseeable without proper study and improvement. However, existing studies indicate that this city structure has generated a number of social, economic and environmental problems (Nieminen 2012). With the huge urbanization of Chinese cities anticipated in the next 30 years, it is important to question if this is the appropriate form and structure for Chinese cities in the future; and if not, it is important to find inspiration or potential solutions that other countries might possess that can help China.

This was proved to be an extremely significant issue at the end of 2015, almost 18 months after this thesis had started. The China Development Bank Capital (CDBC) published a report named ’12 Green Guidelines’, which points to similar problems as are raised here. It also raised the desire to seek possible solutions as there are no successful case studies in China and few internationally, which are also limited and dispersed in scope (Huang et al. 2015, p.4). Therefore, with a successful experience of urbanization and a well-operating Superblock structure in Japanese cities (Hein 2008, Sorensen 2011 and Shelton 2012), these may provide potential clues to improve Chinese cities.

This study of the Supergrid and Superblock structure can provide a good reference for China’s problem and even for cities in other Asian countries. Because of the widespread occurrence of this urban structure, the results of this study are not limited to China and Japan: it can provide inspiration for city development across a wider geographical and cultural realm. Academically, this proposed research will be the first comparative study of Superblock morphology in Chinese and Japanese cities: it will also extend the exploration of Japanese Superblock morphology as well as provide inspiration for old city renewal, city extension and new town development in China. More fundamentally, this study synthesizes a number of important urban design studies that have been
completed since 1960 and deal with various theoretical aspects of ‘interconnection” in cities. It discusses the relationship between this theoretical work and the design and form of Chinese and Japanese cities, and how these urban forms resonate with certain theories that demonstrates their validity. In addition, the study contributes a number of new morphological mapping techniques for exploring interrelationships between form and function of city structure in urban design. This thesis would effectively take us beyond the scope of the Superblock in the two countries, and prompt further studies of its implication in other places where this structure is prominent.

1.6. Research Limitations and Risks:

A limitation of this study is the limited number of Superblocks it is able to cover. With more resources and people, more Superblocks could be investigated to make a more a comprehensive study of the Superblocks and how they work with each other in Supergrids as systems. Although a part of this study is to understand the background and development of the Superblock structure in Chinese and Japanese cities, the core intent of this research is concerned with urban design principles for today rather than being a historical study. The intention is not to discover the details of how China influenced Japanese planning, or how the West influenced Chinese and Japanese planning, it is to focus on the contemporary conditions and performance of Superblock structures in China and Japan through observation of structure/form and flows/use relationships. Exploration of history is limited to the extent that it informs the understanding of the present structure and condition of connection.

1.7. Thesis Structure:

Figure 1.7 below provides a general summary and overview of the structure and content of this thesis.
Figure 1.7 – Thesis structure diagram (by author)
Chapter Two
Culture, History and Urban Morphology
2.1. Introduction

'Of course, culture is what makes architecture and cities distinctive to begin with'.

---------Yoshinobu Ashihara (1989, p.14)

Culture is an underlying and formidable power that differentiates cities by sculpting similar and dissimilar urban forms and spatial structures. It is also the product of the interweaving of philosophy, social norms, religion and politics that has a tremendous impact on the way people conceive the world, understand space and further, how they construct their urban environment. In other words, cities are not only composed of buildings and various physical entities, they are also the direct manifestations of different cultural constructs of human societies. The physical forms of cities are created and shaped by the cultures that inhabit them, and in return, the urban forms reshape these cultures. It is the inextricable and dynamic interrelationships reinforce and write the histories of cities. Just as Hillier states that ‘through the idiosyncrasies of style, building and settlement form becomes one of the primary - though most puzzling and variable - expressions of culture’ (1996, p.16).

While the Supergrid and Superblock Structures in Chinese and Japanese cities not only differ from those of other countries because they are different in forms, they are also culturally incarnated, codified and utilized in dissimilar ways. In order to understand the modern structure in the Eastern context, it is important to appreciate the cultural discourses that fabricate them. They are not just the products of modernization, but also built upon layers of the past that is culturally congruent and carry the imprints of an Eastern urban paradigm. In other words, the central idea of this chapter is to understand how the Supergrid and Superblock structure has been generated by different cultures and evolved through history in two countries to result in divergent forms in their modern cities.

This chapter is divided into three major sections by reviewing the cultural influence and historical transformation of the structure in Chinese and Japanese cities. It firstly discusses the similarities and differences of the spatial conceptions between the two
countries and how they formulate principles that can affect the design and planning of building and cities; secondly, this chapter critically reviews how this structure has been transformed morphologically through history; and thirdly exams the existing studies that discuss the contemporary conditions of this structure. Three arguments can be summarized from each section:

1) The Supergrid and Superblock urban structure is formed under the influence of the same Eastern Areal (lateral) thinking that underpins a multidimensional spatial conception, but different spatial demarcations that are oriented towards ‘wall’ and ‘floor’ that create disparate urban forms. While this Areal thinking presumably is a counterpart of the Western linear thinking, the different inclination of space is strongly responsible - if not determinant to the formation of different types of Superblock in the modern cities.

2) Such different emphases in spatial conception and strategies have led the two nations walking into divergent evolutions of cities in history that reinforce and amplify the structural differences.

3) The modern structure as a result of the evolution creates two similar but also different urban forms in contemporary cities: one is generating more socioeconomic problems that are caused by the conflict between traditional culture and modern functional use of cities, while the other one is well-adapted and performed in the exchange of socio-economic properties.

This chapter also sheds light on how and what formulates the structural similarities and differences in Chinese and Japanese cities? How does culture influence design philosophies in China and Japan? How does urban morphology transform along with the changing cultural expectations? And how are physical elements of cities re-used?
2.2. Culture and Spatial Conception

China and Continental Europe are generally recognized as ancient sources of two major civilizations in the world and commonly referred to as ‘the East’ and ‘the West’ (Craig 1979, p.50). The ontologies of the East and West have formulated two interesting but disparate systems of and epistemologies under different social, political and climatic impacts. Most importantly, the cultural differences between the two sides of the world have created very different physical structures that constitute cities. While the Western urban structure is much well known, studied and praised, the Eastern born and bred Supergrid and Superblock structure has received very limited discussion and is not well understood, especially of how the traditional culture affects the physical structure in the modern Chinese and Japanese cities.

2.2.1 The East and West: The Areal and Linear Thinking


While culture can incarnate into various forms of articulation, words of a language are often seen as ‘the index of culture’ and ‘a means of spatial expression’ (Chang 1982). The human mind has the habit of handling ‘configuration unconsciously and intuitively, in much the same way as we handle the grammatical and semantic structures of a language intuitively (Hillier 1996, p.4)’. This interesting observation between language and city structure reveals a possible relationship of how spaces are perceived under the influence of culture, and how it affects the design of the structure of a city.

Among some existing studies, Shelton (2012) specifically argues that the Eastern Areal and Western linear understanding of space, are related closely to their languages and writing systems, and contribute significantly to the Eastern Areal/lateral and Western linear/radial city structures (See Figure 2.1). He states that ‘writing and page layout are both acts of spatial arrangement’ (p.16), which are similar processes as city design and place-making. This cultural logic of the placement of objects in space can create mindsets that give different cultural perceptions of space through the language system at a person’s early age.

He compares the connection between language and city structure and concludes that the writing of pictures in Chinese or Japanese reveals an ‘Areal’ understanding of the space in multi-directions. In comparison, the writing system in the West is structured in lines that need to be placed in certain orders and directions to express meaning, and this nurtures a habit of thinking and creating in a linear fashion and in a single direction. The perception of space, therefore, can be seen as Areal and Liner in the East and West respectively. This can be linked correspondingly to two types of urban structure: the Eastern multi-directional grid and the Western linear radial web in Japanese and Western cities. These represent two kinds of cultural perception of space as implied in the two languages: the Eastern Areal (lateral) and Western Linear thinking.

This difference between eastern and western city structure is also observed and discussed by some Chinese and Japanese academics. They also read the Western cities
as having a primary radial structure in combination with a small grid as secondary structure, in comparison to a fractal repetition of a grid structure at different scales in Chinese and Japanese cities. Both Zhao (2008) and Zhu (2010) directly point out the structural differences: that China has a Supergrid with Superblocks compares to the Western small grid structure with street blocks (see Figure 2.2).

![Figure 2.2 - Eastern and Western city spatial structures (by Author, based on Zhao 2008)](image)

The former distinguishes the construct and scale between the Eastern Supergrid (with road intervals typically at 500 to 1200m) and Western radial structure with small grid network (with street intervals normally between 50m to 250m). While the latter discusses the cultural and philosophical grounds that foster the difference by providing a theoretical framework, and further specifies that the Chinese city grid is an internalized spatial territory with walls and gates, whereas the Western Cardinal grid is an externalized grid with more emphasis on the nodes and intersections (Zhu 2010, p.107). Similarly, Kataoka (1916) also remarks that this radial and grid difference in the Western and Japanese cities from a planning perspective. He also points out the limitations of the Western radial structure and appeals for limited and wise application in Japanese cities (p.150-200).
From those studies, it is important to note two messages here: 1) the city structure refers to the organizational structure of spatial relationship in cities at the macro scale. The small grid in the West does not equate with city structure. It is only a street pattern or layout within a radial structure. The use of a grid network in the East, as the Supergrid and Superblock, is a city structure that exists above the grid layout. It is not that the Grid network does not exist in both Eastern and Western cities, but that there are differences of scale and hierarchy between the two. 2) Supergrid and Superblock structure also can be found in some modern Western cities, but the idea of a spatial relationship is still a Radial and Linear structure. In Milton Keynes, the macro road structure is a Supergrid and Superblock structure but, at the same time, radial thinking is strongly apparent in the way permeable Superblock structures with small local centers surround a single dominant functional center one would find in a city that has a macro-scale radial structure².

![Figure 2.3 – Conceptual diagrams of Eastern Supergrid and Superblock (The Classic Chinese City Model in Diagram, Steinhardt 1990, p. 34; Originally from Nalan, Sanli tu, pt.1, juan 4/2b, left), Western Radial Structure; Vitruvius, Design of a City (Illustrated by Cesare Cesariano, 1521, middle, Peterson 2012); Filarete’s ground plan for the city of Sforzinda showing a radial design of cities, Hanna 2012)](image_url)

Reflecting back to Shelton’s identification of respective Areal and Linear tendencies in Eastern and Western spatial thinking, it is reasonable to conclude that the radial structure in the West is a direct counterpoint of the Supergrid and Superblock structure in the East that embodies different epistemologies from two contrasting dominant cultural backdrops: the Multi-directional grid and Linear Radial web (see Figure 2.3).

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² It is also the same spatial logic that was used in the Garden City by Howard and the Bentham’s Prison Panopticon.
2.2.2. Similarity: Areal Thinking, Multi-Dimensional Conception of Space and Multi-directional Urban Structure

Adopting this idea from Shelton, this thesis argues that China and Japan share a similar Areal thinking, which represents one of the core values of the Eastern culture. This Areal thinking is manifested in various aspects, and the most unequivocal representation of the idea is the use of the Chinese characters as a major component in their language system. The origin of the Chinese characters can be traced back to the mental habit of translating observable and experiential natural phenomena and forces into illustrations and pictographs thousands of years ago (Boudonnant and Kushizaki, 2003, p. 197). The ideograms are miniatures of things in nature ‘to catch the universe as if they were an image’. They also represent the ‘laws of the universe, since they are an attempt to signify what exists through a visual presentation of patterns’ (Belfiore & Liotta 2012, p.11), and to encapsulate the worldview and visualization of structures of the Chinese and Japanese spaces.

In other words, the key to understanding the Eastern culture is to appreciate multiple interrelationships between parts and whole of the Areal structural arrangements (Li and Yang 2007, p.50-58). Just like the ideograms, the same characters that are confined within squares and arranged in different spatial relationships can result in different meanings and connotations (see Figure 2.4). Hence, being able to arrange things in multiple directions in an ‘Areal’ setting becomes a mental ability of the Chinese and Japanese through years of training and practice, and it can be called the multi-directional spatial conception (Shelton 2012).

Figure 2.4 - Chinese Characters in Matrices and Different Placements of the Same Characters in the Same Square Block Base (by Author)
Such spatial logic of creating Chinese characters in matrices at the micro level (part) is also applied in the arrangement of characters into sentences and texts at the macro level (whole). Not only each character illustrates an image individually, all characters together also depict the meaning like a ‘painting’, which is the beauty of Calligraphy (see Figure 2.5.1). Moreover, characters can be written and read in multiple directions without compromising the actual meaning (Li and Yang 2008, p.54, Shelton 2012 also illustrated in Figure 2.5.2). Similarly, Japan also adopted the Chinese characters as part of their language system, and their spatial conception is further strongly influenced by the miniature of worldview in each character. The way of arranging the characters as texts also allows the reading in multi-directions. In other words, understanding the language becomes a very crucial bridge to comprehend the Chinese and Japanese spatial conception and city structure (Chang 1982, p.10 & Shelton 2012, Chapter 2, Wang 2012, p.173).
Furthermore, space is not only considered as a multi-directional physical construct, but also a multi-dimensional experience, which can be considered as the essence of Chinese and Japanese spatial conception. This can be seen clearly from the basic concepts of space, which is written as 空間 $\text{間}$ in both Chinese and Japanese. While the two characters represent a Western concept that refers to a three-dimensional spatial conception building upon the Cartesian system, which didn’t exist in traditional Chinese and Japanese culture and spatial conceptions, they were used separately in the ancient time to indicate different meanings and connotations (Li & Yang 2007, Isozaki 2011, Chapter 6). The first character 空 means emptiness and void, and the character 間 means gaps, interstices or chasm between space and time; Or as indicated in Figure 2.6, it refers to the space between two pillars of a wooden frame as an Architectural unit in China and Japan (Gunter 1966 & Li and Yang 2007 & Isozaki 2011, p.94, Belfiore & Liotta 2012 p.56).

![Figure 2.6 – The concept of Jian or Ma (間/間) in Chinese (left) and Japanese (right) Building in Chengdu and Kyoto (by Author 2013 & 2016)](image)

Even though they represent a Western concept, the connotations of the two characters still imply a traditional conception of space in China and Japan. It is a concept that represents the void and gap between solid objects, and more importantly it has the connotation of time being paused (Zong 1988 & Zhu 2004), ‘a relativized and sensorial perception of space’ (Belfiore & Liotta 2012, p.56), or in Isozaki’s words, it is the combination of ‘a series of magical and symbolic space’ and ‘a series of abstract, multidimensional spaces (semiotic space)’ that is intimately interrelated to each other spatially and temporally (2011, p.89-90). Unlike the concept of space and time in the West that are treated as separate entities, space in Chinese and Japanese cultural

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3 The use of the phrase was firstly invented by the Japanese through the understanding of western theory of space, and then China adopts this phrase as part of the modern language only since late 19th century.
conception not only represents a physical construct, but also refers to a series of experiences of time through space or ‘a structure of feelings’ (Li and Yang 2008, p. 50-51, Gunter 1966 & Belfiore & Liotta 2012). In other words, it is not a three-dimensional linear concept, but a multi-dimensional Areal spatial conception that united space and time as one being.

A direct reflection of such spatial conception is clearly illustrated in traditional Chinese and Japanese paintings⁴, which can be considered as a way of creating space in multidirections for multi-dimensional experience and sentiment. The two paintings in Figure 2.7 clearly show the use of multiple point perspective (or 三（六）远法 in Chinese)⁵. They tend to illustrate a series of experiences in an area rather than a physical thing at a specific moment by creating moving visual points and refusing fixed point linear perspective that has been commonly adopted in the West since the Renaissance. Paintings are not only used to watch but also to listen⁶, to live, to play, to experience and to feel. The observers are more than just an audience from the outside as the common habit in the West, but also a participant in the paintings (Li and Yang 2008, p. Belfiore & Liotta 2012, p.60). It is not hard to see that the paintings are embodied with the Chinese and Japanese conception that both sees space and time as inseparable entities and are expressed through multi-dimensional (by Isozaki) and multi-directional (by Shelton) artistic conceptions to create experiential space.

Figure 2.7 – Traditional Chinese (Part of Qingmingshanghetu of Bianliang left, Kun 2008) and Japanese (Part of Ryakuchu-Ryakugai screen of ancient Kyoto, right, Art Gallery NSW,1999) paintings both showing the ancient cities reflecting the Multiple Perspective and multi-dimensional spatial conception

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⁴ Japanese painting mostly adopted Chinese painting techniques and theories before 18th century (Bharne 2014).
⁵ Multiple perspective or Arial/atmospheric perspectives is a western concept that is created based on the observation of Chinese painting from western linear thinking. Qin 2008 argues that there is no perspective or vanishing point in Chinese painting, and hence the use of the term can be misleading to understand Chinese painting and techniques. Moreover, a famous painter in Qing Dynasty, Zou, even criticized the Western drawing techniques and the uses of Perspectives are too superficial. They only capture the physical shapes, and lose the essence of depicting the spirits of objects. It is the opposite of what a good painting is recognized in Chinese standard.
⁶ Chinese paintings are often accompanied with poems and calligraphy at a side. The observer can read, watch and experience the painting at the same time. The three are inseparable and mutually supportive in Chinese culture.
Thus traditional spatial concepts in Chinese and Japanese cultures serve to reinforce Shelton’s notion of ‘Areal thinking’ in these related Eastern cultures: they are both multi-dimensional and multi-directional. In other words, the conception of space in the two countries is not a linear construct that follows the XYZ directions as in Cartesian axes, which in its nature is a product of the linear thinking (Isozaki 2011, p.89-91; Li and Yang 2007, p.34; Bharne 2014, p.101). It is a multi-dimensional construct of space and time that is made up a web of nodes (experience and sense) that contain multiple connections and directions (see Figure 2.8). It is beyond the Western 3D spatial conception that can only be seen as physical structures, but a multi-dimensional spatial construct that is composed of physical, temporal, psychological, non-sequential events, experience, and sentiments. This is extremely important because it clearly indicates the same spatial conception that tangles space and time as interrelated concepts from Chinese and Japanese culture.

By linking those ideas to the Supergrid and Superblock structure, a pertinent continuity can be found in both ancient and modern Chinese and Japanese cities. In the ancient time, both China and Japan adopted the Supergrid and Superblock structure, which was considered as an ideal eastern city-planning paradigm (Lai and Liu 2008). Over two millennia later, a similar structure is widely used in both Chinese and Japanese cities again. In modern China, the major arterial roads of cities are required to be set with an interval between 750m-1200m, which naturally forms a Supergrid with a number of Superblocks in cities. This is written in the planning regulation (Policy No. GB 50220–95) and textbook as a normative code in the education of how Chinese cities should be planned and constructed (Xu 2007, p.202-205). On the other hand, Japanese cities also

Figure 2.8 – Diagrams of the Eastern/ Traditional Chinese and Japanese Areal Conception (left) and Western/ Modern Cartesian (right) Spatial conception (Drawings are made by author based on the discussion from Isozaki 2011 and Li & Yang 2008)
have clear regulations about this hierarchical Supergrid network, which has an average size typically around 1km² (City Bureau of Ministry of Construction 1992 and Japan Urban Planning Society 2003). Structurally, this Supergrid in modern Chinese and Japanese cities provides a multi-directional network that allows transportation movement in all directions without leading to a single center. Functionally, the distribution of various commercial and business activities in Chinese and Japanese cities tends to be well dispersed across the Supergrid (see Figure 2.9).

At this stage, it is possible to see that there is a strongly emerging correlation between culture and city structure, and it is apparent in every aspect of Chinese and Japanese culture and cities, from language to paintings to Architecture and to city design. This multi-dimensional spatial conception under the Areal thinking is a dominant cultural reading of space that is responsible for creating a similar multi-directional Supergrid in both Chinese and Japanese cities and recognized in a range of ways by a diversity of authors.

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7 Tokyo Disaster Reconstruction in 1925; Planning 1km grid and 500m secondary networks. Osaka planning indicates clear 500m grid interval in the commercial center and 1km in the rest of the area

8 Many City governments discussed the application of this concept in their local planning policy and review. Example documents are Osaka City Council 2012 (big size city), Urumaichi Urban Construction Department 2013 (medium to small size city) and more.
2.2.3. Difference: Wall and Floor-oriented Areal Conception

However, even though both Chinese and Japanese have a similar areal thinking and multi-dimensional spatial conception, they also have differences in their appreciation of space, which creates different structures within Superblocks that are responsible for different contemporary urban morphology as discussed in Chapter one.

In considering space, Ashihara (1989) defines Architectural space by three basic elements: the floor, the wall, and the ceiling, and he provides a conceptual framework to identify two types of ordering systems: one that is characterized by the wall and the other by the floor (see Figure 2.10). He propounds that Japanese conception of space can be understood as the ‘Architecture of the floor’, while that of the West is an ‘Architecture of the Wall’ (1982, p.3) and even suggests that ‘Chinese Architecture is more West than East’ (1989, p.135). However, despite the common use of the wall in both Chinese and Western cities, it does not bring Chinese architecture or urban design any closer to Western since in China it has been an adjunct to a spatial conception that is primarily Areal and rectilinear in nature as discussed above. Nevertheless, it does reveal an important difference between Chinese and Japanese Architecture and the related spatial conceptions, and that is in the use of the wall. Adopting Ashihara’s framework, this thesis argues that China has a more Wall-oriented spatial conception (both 2d horizontal and 3d vertical), whereas in Japan it is more floor-oriented (2D horizontal plane).

Figure 2.10 - Comparison of Chinese and Japanese Spatial Conception: Wall and Floor (by Author)
It is similar to the common use of Chinese ideograms in both written language systems, which are characterized by very different syntax and sounding systems. Chinese as an isolating language uses monosyllabic morpheme in each character that is confined by a system of ‘rigid and bony block structure’, whereas Japanese is an agglutinative language that is polysyllabic, ambiguous and ‘characterized by a weak syntax’ (Belfiore & Liotta 2012, p.6). It has more ambiguity and fluidity because of the introduction of Kana system⁰ creating different ‘mental context and spatiality’ from the Chinese (see Figure 2.11). As a result, spatial conceptions in the two countries share a very similar rule with their language syntaxes as they do in structuring spaces: with China having a clear hierarchical space that is well defined by a series of wall structure (like the block structure in writing characters). In comparison, Japan is equipped with a ‘non-dominant hierarchy, a de-centered and extended fragmentation of space’ (ibid. p.6) showing a new mental spatiality (Okazaki 2003), which are further extended to Architecture, Urban design and planning (ibid. p.14, and Takashi 1999).

Chinese culture has a major focus on the idea of enclosure and containment to reach a balance between conflicting things (Li and Yang 2007). Traditionally, while ‘宇宙 (Yuzhou)’¹⁰ was more often used to represent the co-existence of the limited space and unlimited time as the traditional Chinese spatial conception, its connotation implies a dynamic containment between space and time in order to reach a balance (Zong 1981).

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⁰ Kana system is a part of Japanese writing system, which includes Hiragana and Katakana two types of syllabic scripts. These scripts are used together with Kanji (Chinese characters), and also to pronounce foreign languages.

¹⁰ 宇 (Yu, space or architectural space) 宙 (Zhou, time) is originally from Wenzhi - Nature chapter ‘四方上下謂之宇, 古往今來謂之宙’ (meaning: the space above, in the middle and below is called Yu, while past, now and future is called Zhou). The two characters are used together as one concept that refers to how Chinese conceives the space. While 宇 is limited, 宙 is unlimited. 宇宙, 宙合, 天地, 風, 八方 are all used to describe similar interconnected space-time concept.
It can be considered as the ‘equilibrium of Yin and Yang’ from Taoism; the ‘moderation of extremes and mitigation of conflict’ ( 中庸) from Confucianism; and the ‘reoccurrences and reincarnation’ (轮回) from Buddhism (Li and Yang 2007). Or as Zong 1981 specifically points out that it can also be summarized as a quote from Yijing (易经)

There are forces that always come and go in a dynamic motion indicating the unlimitedness of the limited space (无往不复，天地际也). In other words, the Chinese believe that the infinite time can only be captured and understood through finite space (See Figure 2.12). As a result, it nurtures a strong sense of spatial enclosure through a pervasive use of the wall structure that can be termed as ‘the wall-oriented spatial conception’. The wall structure is more than just a defensive structure; it is also a systematic metaphysical structural mechanism to create interconnections between everything in the universe for the balance and unification between human and nature (Zhu 2004 & Li and Yang 2007).

![Figure 2.12 – A diagram of Illustrating the Chinese Conception of Space (by Author)](image)

Entering the Chinese academic theater of discussion, both Chinese, and non-Chinese academics recognize the pervasive use of wall structure in cities and think that ‘A wall is a key element in the formation of space in the Chinese conception’ (Zhu 2004, p.46). Any Chinese Architecture that is composed of a number of buildings would not exist without walls to create series of architectural experiences (Ding 2012). Any Chinese characters and phrases that relate to a city also indicate that a city ( 城) would not be a Chinese city without walls (Wheatey 1971 and Xu 2000). The earliest formal concept of Chinese urban design and planning can be traced back to the Kao Gong Ji in Zhou Dynasty (1 BC)

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11 One of the most classic philosophical books in China, and the ideas from it is penetrated through every aspects of Chinese culture.
(Steinhardt 1990) and it is again based on the basic rule of having an area that is walled to begin a city. Just as Zhu (2004) summarized: ‘at a structural level,’ Chinese cities are ‘constructed by a system of walls, not by a field of open spaces that are naturally related and congregated to each other’ (p.46); and ‘at a spatial level, the city walls are the only material and constitutive element that defines this overall concentric, hierarchical composition’ (p.48). Spaces are hence ‘fragmented, dissected, enclosed, localized and relativized’ (p.50-51). Moreover, some studies also specifically point out that the walls and gates are the special characteristics of Chinese urban design and planning in demarcating space and they are the inseparable parts of Chinese culture and religion through thousands of years of evolution (Lu & Bozovic-Stamenovic, 2004, Lu 2006, Nieminen 2012). Walls are not only a physical but also functional and psychological features that construct Chinese cities and society (Boyd 1962, Chang 1977, Mote 1977, Steinhardt 1990). Therefore, the construction of space by using walls in China is not only a device to protect, but also a physical structure that shapes the order of space, to create unity through diffusion, centrality through decentralization, and concordance through separation (see Figure 2.13).

![Architecture of the Wall](image1.png)

(1) Architecture of the Wall
(Ashihara 1983, p. 10)

![Residential Courtyard Compound](image2.png)

(2) A Residential Courtyard Compound of a big family (Wang 2007, p.314)

![Walled superblocks/compound](image3.png)

(3) Walled superblocks/compound for residential uses (Xu 2000, p.70)

![City Wall of Xi'an](image4.png)

(4) The City Wall of Xi'an (by Author 2015)

Figure 2.13 – Walls are used as an architectural element to enclose and create single building (1), groups of building (2), Superblocks (3) and city (4) showing the pervasive use of wall structure in China since ancient times.
In comparison, Japanese spatial conception is also metaphysical, and its special character can be considered as the embodiment of *Ma* (間) /void (Isamu 1963, Gunter 1966 & Isozaki 1979 & 2011), or in Ashihara’s words: ‘The Architecture of the floor’\(^{12}\) (1983, p.10). It is a ‘productive emptiness like a place prepared and purified to receive the gods (Isozaki 2011, p.100). ‘*Ma*’ also resonates the philosophy of absolute nothingness (無の境地), which is stressed by Nishida Kitaro\(^{13}\) as the foundation of Japanese culture (Nishida 1958). It is an ‘intuitive grasp of the ‘formless and voiceless’ rather than concrete things’ (Belfiore & Liotta 2012, p.11; Fu & Heine 1995, p.55). A similar discussion is also given by Bharne (2014), he remarks that the traditional sense of space in Japan is like ‘an organic void – had no beginning and no end (p.85)’. Roland Barthe's famous comment also indicates the presence of a central void in Tokyo: ‘it does possess a center, but the center is empty... the sacred nothing... an empty subject’ (1982, p.30-32). Just like Kazuo Shinohara states that the meaning of space in Japan is to take out rather than to put in as in the West (Wilson 1989, p.18).

![Figure 2.14 – A Diagram of Japanese Spatial Conception of Ma (by Author)](image)

*Ma* can also be understood as the *Philosophy of Symbiosis* (Kurokawa 1991), the *Rikyu* grey (Kurokawa 1991, Chapter 4), the bi-dimensional spatial layering (Belfiore 2012 from Kuma’s Lab), the ‘Hidden Order’ of Japanese society (Ashihara 1989), the concept of *Oku* (Maki 1979), and the intermediary space (Ashihara 1983, Kurokawa 1991, Maki 1979 and Bharne 2014). It represents the sense of impermanence, incompleteness, and imperfection under the influence of Buddhism, which can give birth to unlimited possibilities and spatial expansion (Ashihara 1983, p.10). Moreover, it indicates a more

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\(^{12}\) The concept of *Ma* poses a strong emphasis of the idea of ‘boundarylessness’. In other words, it means the focus of allowing spaces to expand unlimitedly as a plane, which means the ground or floor becomes the decisive element in constructing space.

\(^{13}\) A prominent Japanese philosopher, he is the founder of what has been called the Kyoto School of philosophy.
open, fluid, flexible, ephemeral, atmospheric, transparent and porous sense of space. No clear boundary is needed to enclose space, but an ambiguous border between man and nature, inside and outside (see Figure 2.14). More importantly, it allows ‘the juxtaposition of different things and the expansion of space in multiple directions’ (Ashihara 1989, p.55).

Although the use of wall is also common in Japanese cities, it is more symbolic and less prominent. While the emphasis in creating space is to allow constant change to happen in space, the use of the wall in Japan hence means less emphasis on a strong physical outline in spatial demarcation (Ashihara 1983, p.10 & 1989, Bharne 2014 & Shelton 2012). The boundary between spaces is not necessarily a physical structure. It can be a sign, the flow of people, and a change of pattern on the ground or other subtlety (See Figure 2.14.1 and 2.14.2). Even when there is a need to build a boundary, the choice of material would usually favor timber or wooden frame (lighter material) to create an intermediary space and give a sense of ambiguity between inside and outside in buildings and cities (Isozaki 2011, Ashihara 1983, Bharne 2014, Kurokawa 1991, Chapter 6, Belfiore & Liotta 2012). To sum up, the pursuit of the unlimited space as a void in the culture gives a particular appreciation of spatial openness with a stronger emphasis on the floor and ambiguous boundaries hence reinforces a floor-oriented spatial conception.

![Figure 2.14.1 - Architecture of the Floor Wall (Ashihara 1983, p. 6)](image1)

![Figure 2.14.2 - Japanese Ritual: a Symbolic Wall (Ashihara 1983, p. 12)](image2)

The wall and floor oriented spatial conceptions affect the respective construction of space in Chinese and Japanese architecture can be seen in the following ways.
2.2.3.1 The Solid and Void:

In China, space can be considered as the solid is in the void (infinite) and the void (finite) is in the solid, they are contained within each other (Li and Yang 2007, Chapter 3). Correspondingly, spaces in buildings or cities are arranged by enclosing voids with solid walls, which are used as structural tools. While the Chinese courtyard compounds ‘can be viewed as a void or nothingness from outside, it is also a ‘solid’ center from within (Zhu 2004, p.224)’. As indicated in Figure 2.15, the buildings (the solid), representing the limited space, is used to enclose the yard (the void), which embodies the unlimited time and invited nature from outside. Corridors provide an ambiguous transition between the solid and void to moderate a clear contrast between human and nature. At the same time, a sharp distinction between inside and outside can be maintained by the use of the solid wall. Even the use of the material in Chinese Architecture is also a mix of solid (brick wall) and void (wood frame and column). In other words, the beauty of creating a Chinese sense of space lies in the ability to enclose the void in solid to reach a perfect balance between the human (inside) and nature (outside). The use of the walls becomes the most important structural key that can generate a space that contains both void and solid in a space (Li and Yang 2007, p.113-120), and the Chinese courtyard is a perfect manifestation of such idea.

In comparison, ‘form is emptiness and emptiness is form’ is given as the most important principle for the generation of space (Belfiore & Liotta 2012, p.11), and it represents the essence of Japanese spatial conception, Ma. The result of such spatial conception is that Japanese architecture relies on sliding screens with posts and beams to bear the load as the structural skeleton - as Atsushi Ueda states (1990, p.11), ‘the history of Japanese Architecture is the struggle with the pillars’. At the same time, spaces between pillars
are demarcated with flexible paper sliding doors (shoji), folding curtains and wooden screens (fusuma) that can be seen as flowing void/Ma, rather than ‘something defined by the heavy material and existential presence surrounding walls’ (Ashihara 1983, p.10-12). ‘Ma’ is utilized to blur the boundary between each potential room, and to create spaces that are ‘neither indoors nor outdoors’. These spaces are ‘not even in between’, but are ‘an intermediate space that connects the interior space to nature’ with ‘its own atmosphere’ (Belfiore & Liotta 2012, p.14).

In other words, while ‘Japanese architecture is a treasure-trove of boundary techniques’14 (Kuma 2010, p.15), and the engawa is the best example of such space in Japanese architecture (see Figure 2.16). Unlike the corridors in Chinese courtyard that are used to provide transitions to the internalized nature, it is a direct threshold between interior and exterior to allow the inside to ‘melt’ into nature outside. By changing the position of the sliding doors, the whole house can be completely opened to the outside and human and nature become inter-penetrable and flawlessly blending within each other (Ashihara 1983 &1989, Kurokawa 2001, Belfiore & Liotta 2012). In other words, the use of frame and pillars in buildings to define vertical space as the void reflects the emphasis of the floor as the only solid entity and hence a floor-oriented conception.

![Figure 2.16 – Engawa of Japanese Buildings (left, Aya7sa 2013; right, by Author 2015)](image)

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14 The techniques involves the use of different forms of screen, such as shoji and giangji panels, different kinds of folded screens and adjustable space dividers, and intermediary space like the engawa, verandas or corridors (Servinaki 2003).
2.2.3.2 Brightness and Darkness

The second important technique for creating space in Chinese architecture emphasizes the idea of brightness and darkness dynamically contained within each other to reach a balance. 'One bright and two dark' or 'three bright and two or four dark'\(^{15}\) are commonly used rules to create buildings with such conceptual spaces (Wang 2008, p.41). The use of the walls and gates structures a hierarchical social order through creating a number of 'bright' and 'dark' spaces\(^{16}\). Depending on the size of a courtyard, the parts in the composition of each building are endowed with qualities of being 'bright' or 'dark', which are subdivided into a number of sub-units by walls (Figure 2.17 right).

Moreover, the wall and gate structure create depth within a courtyard compound. The larger the compound gets, the more depth it will have (Zhu 2004, p.103-118). However, greater depth is not associated with darker space as usual in this case. This is because a yard for each sub-unit creates a space in the light that keeps the ‘bright’ and ‘dark’ in balance with equal distribution (see Figure 2.17). This concept is also used in designing the landscape to create a more diversified spatial experience through the separation and connection of the wall structure (Xu 2007 & Zeng 2010). In such ways, the ‘bright’ and ‘dark’ spaces penetrate in every aspect of the building and landscape, and the use of the wall structure is to balance the brightness and darkness in space by separating spaces into a number of sub-units.

\[\text{Figure 2.17 – Chinese Courtyard Depth (left, D1-D5 represents the number of depths) and Bright and Dark Space (right)}\]

\(\text{(the one on the right is, adapted by Author from Wang 2008, p.40, the left one is made by author)}\)

\(^{15}\) In Chinese, they are called 一明兩暗, 三明五 (七) 暗

\(^{16}\) In ancient time, commoners were not allowed to have a single building that was more than three rooms. The solution was to build two smaller buildings with separate yards that were detached from the main building (with three rooms) to create the same amount of space. They are divided and linked by walls and gates. The two smaller buildings are classified as dark space, while the main building is the bright space (Wang 2008, p.41).
Whereas the Japanese has a special appreciation of shadow and darkness: space for living is therefore made by ‘spread(ing) a parasol to throw a shadow on the earth, and in the pale light of the shadow we put together a house (Tanizaki 1977, p.17)’. While numerous themes of darkness pervade Japanese architectural history (Bharne 2014), it tends to have a positive connotation in defining spatiality (Belfiore & Liotta 2012). Just like Bharne (2014) states that ‘traditional Japanese architectural space was experienced as much through darkness as light. It was less about reading size, geometry, and form’, (...) but ‘more about the perceptual experience of minimal light playing in a void (p.115-116)’.

As a consequence, ‘the beauty of a Japanese room depends on a variation of shadows, heavy shadows against light shadows – it has nothing else’ (Tanizaki 1977, p.18). Space in Japanese cities are created with great depth, which can also be understood as the ‘philosophy of inner space’ or Oku (inner depth). Maki (2008) has probed the idea most: Oku is a spatial arrangement to suggest depth and to create ‘perceptual remoteness within limited space like an onion’, (...) ‘topography, trees, screens and other framing devices can all be used to endow urban space with Oku, as can the treatment of natural light’ (see Figure 2.18).

Figure 2.18 – These are diagrams of depths and the photographs show the kind of equivalent space in the Osaka Superblock – Oku Space and related levels of shadow in space (Diagrams are adapted by Author from Maki 2008, photos are taken by Author)
Such depth was also discussed by Tanizaki as ‘being expressed in the suggestive quality of natural light, whether inside or outside (ibid.p.170)’. In other words, space with more depth is associated with darkness, which can also be considered as a form of light. Such space ‘represents an implicit in the conceit of darkness at the heart of the forest’ (Isozaki 2011, p.77), and becomes ambience that is immersed with shrines hiding in the deep mountains, tea houses that can only be reached by going through shadowed meandering paths with heavy plantations; and spaces that are hidden in the shadow of long and heavy roofs (Figure 2.19).

‘The space of darkness (therefore) probes an individual’s consciousness to its very depths, while the space of emptiness logically analyses an individual’s personality in a diversifying, complicating sweep’ (Isozaki 2011, p.89-90). While a spatial conception that senses the space as an unlimited void and nothingness with ambiguous boundaries, darkness as the light in space with depths can be considered as an incarnation of spatial technique in creating space of Ma and it further reinforces the idea of floor oriented spatial conception.

Figure 2.19 – Temple Shoren-in indicating the Use of Darkness as light (City of Kyoto and Kyoto Convention & Visitors Bureau, 2017)
2.2.3.3 Static and Dynamic: The ‘2D + 3D’ and ‘2D’ Areal Spatial Conception

In Chinese culture, the words ‘static’ and ‘dynamic’\textsuperscript{17} in relation to spatial conception and production can be better interpreted as \textit{xīng} (form) and \textit{shi} (propensity). ‘\textit{Xīng}’ refers to the static form that is seeable in close distance or ‘locally’, whereas ‘\textit{shi}’ refers to a dynamic propensity that is only observable at a distance or ‘globally’\textsuperscript{18}. \textit{Shi} as a dynamic force cannot be formed without a collection of a large number of \textit{xīng} as static individualities, and the two must be contained within each other to reach a balance (Wang 1992 & Zhu 2004). The creation of such space is through the use of the wall to accumulate smaller shapes (\textit{xīng}) into a force of propensity (\textit{shi}) to form a strong multidimensionality. Horizontally, they are fragmented to divide, but vertically they incorporate to unite. In other words, space in China is perceived both horizontally and vertically (see Figure 2.20). Moreover, the use of walls also plays a similar role in the social structure of Chinese society: to separate people with different social status and to unite ‘differentiated segments’ into a hierarchy of social-political institution (Zhu 2004, p. 224). Spaces are therefore both fragmented and united by the wall structure that can be seen in the close distance as a static 2d plane (\textit{xīng}) and to be felt in long distance as dynamic 3d holograph (\textit{shi}).

\begin{figure}[h]
\centering
\includegraphics[width=0.7\textwidth]{example.png}
\caption{An Example of the \textit{Xīng} (Left, Hellier 2014), and the \textit{Shi} (right, Beijing University of Aeronautics and Astronautics 2016) qualities of Buildings in Chinese Spatial Conception. \textit{Xīng} indicates the focus on the physical shape of the singular building, while the \textit{Shi} can be felt through the collection of many buildings together.}
\end{figure}

In comparison, the Japanese spatial conception is rather biased towards the idea of spatial dynamism, which has its origins in the fluidity of ‘\textit{Ma}’. It indicates a boundaryless space with constant change and has a strong two-dimensionality and frontality.

\textsuperscript{17}The third concept is about seeing the static and dynamic in space, the use of the word indicates a western reading of space, but it is not the same in Chinese and Japanese spatial conception. Unlike the western idea of dynamic and static is only about the physical structures, the \textit{xīng} and \textit{shi} are about both the shape and the feeling.

\textsuperscript{18}The two words are used to echo Hillier’s terminology and concepts of space, which are discussed in the in Chapter 3.
This is depicted by Chang (1987), who proclaims: ‘the notion of flowing space depends on the notion of infinity, where space extends infinitely in two directions’ (p.169), and ‘it is predominantly horizontal (p.163-8)’. Because space is mostly seen as two dimensional, it has greater flexibility and fluidity as a dynamic system.

Similarly, Kuma sees this bi-dimensional spatial layering as ‘the use of layering succeeds in giving Japanese architecture a sense of opening and a well-organized space’ (Belfiore 2012, p.1). Kurokawa (1991) also sees the dynamism and fluidity of space as the Rikyu Grey and symbiosis. In the description of the city of Kyoto, he remarks that all the elements of its architecture tend to dissolve in the ‘grey light of dusk’, losing every perspective and three-dimensional character, and reducing ‘the world of three dimensions’ to ‘a flat world’ (p.73). This two-dimensionality in Maki’s eyes is the ‘inner space envelopment’ and gift-wrapping (2008), and it is also what Ashihara (1989) called the ‘Amoeba’ quality of Japanese cities. In Tange’s words, ‘instead of defying gravity, the Japanese have preferred to seek space in which to spread out horizontally’... ‘The organization and balance of forces are reduced to two dimensions: what one has is a succession of planes (1960, p.23)’.

As a result, a Japanese room is usually designed through a process of Okoshiezu (起こし絵図). Walls are treated as planar autonomous compositions that were laid on the ground first and the lifted vertically to make a flexible enclosure (see Figure 2.21). It is ‘less about containment and more about wrapping space like a gift paper, it is more implicit and less protective (Bharne 2014, p.107)’. In other words, the wall is like an extension of the floor as a two-dimensional spatial expansion in multi-directions with boundary-less-ness and transparency. Again, this reflects the floor-oriented spatial conception.

Figure 2.21 – Shoin and Tea House (left, Bharne 2014, p.84); and an example of Okoshiezu (right, Sadwat 2009) showing the two-dimensionality and frontality of Japanese Conception in Constructing Space
2.2.3.3 Wall and Floor oriented Spatial Conception & Its Impacts on Urban Design

2.2.3.3.1 Part and Whole:

Ashihara (1989) proclaims that the Chinese cities are built from whole to part, whereas the Japanese cities are built from part to whole (see Figure 2.22). This is evident in both their ancient and modern planning. In the ancient model, the use of wall structure is to define boundaries and this means that cities are planned from the whole to the part by laying out the Supergrid first (Wang 2007). Similarly, the construction of the modern wide road network is also a top-down infrastructure (Wang 2014a). In contrast, the planning of Japanese cities does not start from a whole plan. The design of the four Japanese ancient capitals changed from the Chinese planning methods (from whole to part) to the more local method (of part to whole) in order to adapt to the Japanese cultural and political context (Wang 2007). The modern Supergrid, in comparison, in Japan results from a land readjustment process that is influenced by both a top-down and a bottom up movements (Sorensen 2011).

Figure 2.22 – The Part and Whole relationship in Chinese (left) from whole to part in Japanese (right) cities from part to whole (by Author)

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19In the Chinese model, the Supergrid are laid out first to make sure the global roads are equally distributed, whereas the Japanese changed the method by creating equally sized street blocks and Superblocks first and then laid out the Supergrid to make sure an equal land subdivision and distribution (Wang 2007).
2.2.3.3.2 Centrality and Asymmetry

Centrality is strongly favored by the Chinese and widely used in the design of building and cities, while the Japanese mastered the asymmetry, which has infiltrated in almost every aspect of their lives. Unlike the western axis that focuses on a strong and dominant center, the centrality in Chinese city planning follows a decentralized experiential axis that is made of a number of fragmented microcosms\(^{20}\) (Boyd 1962, Zhu 2004). This centrality can only be achieved by using a system of walls and gates to create a hierarchy of spatial containment to unity and separate space across different scales. In comparison, the floor-oriented spatial conception allows the asymmetry spatial organization becomes possible and pervasive in Japanese cities (see Figure 2.23). This is because it is constructed from part to whole and expands from a void center in multi-direction with little spatial obstruction. This planning difference in Chinese and Japanese Supergrid and Superblock structure can be seen as two representations: a more regular and symmetrical Superblock structure with a pervasive use of wall structure in China; and a more irregular and asymmetrical structure in Japan with limited use of walls\(^{21}\).

![Diagram showing the difference in spatial arrangement of urban elements (buildings) in response to axis to form symmetrical and asymmetrical pattern](by Author)

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\(^{20}\) The ‘fragmented microcosm’ is adapted from the sentence: ‘Beijing is fragmented into many microcosms’ from Zhu 2004, p. 234. It refers to the walled (courtyard) compounds by this study.

\(^{21}\) It creates more permeable global roads in north-south direction and more local branches in the other direction in cities; more connected network in all directions.
2.2.3.3 Multi-petal and Multi-fugal Structure:

Chinese and Japanese cities can be considered as having a ‘multi-centripetal’ and ‘multi-centrifugal’ structure respectively. While cities in the two countries both have multiple centers (Lai & Liu 2008, Sorensen 2001 & Shelton 2012) or no center (Bognar 1985, p.67), the Chinese cities orient themselves centripetally to converge their surrounding villages into a hierarchical wall structure (Liang and Sun 2003). In comparison, Japanese cities expand through a fugal-like outward force and ‘demonstrate a centrifugal order ruled by the floor’ in contrast to a ‘centripetal order ruled by the wall’ (Ashihara 1983, p.34). However, the centripetal and centrifugal concepts are a set of linear thinking that is developed from the central place theory and the mono-centered structure of western cities (Liu and Lai 2008). They are less suitable to explain the Chinese and Japanese Supergrid and Superblock structure since they are multi-centered urban structures under Areal thinking. Following this logic, this thesis argues that the wall-oriented conception creates a Supergrid and Superblock structure that has multiple centripetal forces within a number of walled Superblocks, in comparison to a floor-oriented conception that creates multiple centrifugal forces that expand outwards from no centers haphazardly (see figure 2.24).

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22 Lai and Liu 2008 indicates that Chinese Lifang system is a multi-centered city structure that provides dynamic forces between the Lifang units (Superblocks) and the whole system is an agglomeration of the units (Supergrid) (p.57). Similarly, Japanese cities are also multi-centered in their nature (Sorensen 2001 & Shelton 2012) or have no real spaces or centers (Bongar 1985, p.67). Bongar 1985 also remarks that Japanese cities have centripetal spatial structure as ‘represented by the land and nature’ (p.67).
With the discussion of space above, it can be seen that a key difference between Chinese and Japanese spatial conceptions lies with the wall and floor oriented biases, though they are both Areal in their basic construction of space. The Chinese use spatial enclosure and containment to maintain equilibrium, whereas the Japanese abandon the boundary to reach the balance between human and nature. They represent spatial equilibrium and ‘spatial continuity’ respectively in comparison to ‘spatial confrontation’ in the west (Kurokawa 1991). The spatial enclosure and containment are in the form of the wall structure that is pervasively used in Chinese architecture and cities to reach the balance between solid and void, between light and dark, between Xing (form) and Shi (propensity and force). In comparison, the bi-dimensional layering, spatial depth (Oku) and fluidity of space are widely adopted in Japanese Architecture and cities to pursue the sense of Ma, the darkness and dynamism of space as a flat world to reach the ultimate ideal of infinity to blend with nature. Moreover, space in Chinese culture is perceived in a more vertical way than in Japanese. Space is perceived as a holograph in China (Pan 2010), but as a process of Okoshiezu or wrapping a gift with particular of the deduction of space into a 2d and frontal phenomenon in Japan (Kurokawa 1991, Bharne 2014). This gives a different perception of spatial demarcation: a stronger boundary in China, but an ambiguous boundary in Japan, or in other words, the wall and floor oriented spatial conception in China and Japan (see Figure 2.25).

**Figure 2.25 - Wall & Floor Concept of Space at Architectural Scale**
(adapted by Author from Shelton 2012, p. 30, 46)

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23 Kurokawa states that: ‘I would like to suggest that the difference between the western concept of space and eastern concept of space is the difference between spatial confrontation and spatial continuity. Western architecture emerged from a philosophy of confrontation with nature and the impulse to conquer it ... the Japanese concept of space reaches out to embrace nature and to achieve unity and harmony with it.’ Although the western culture divides the outside and inside with wall structure, it is very different since the Chinese culture invites the nature from outside into the inside of human living courtyards in order to reach a harmony between the two (2015, Chapter 6). China has the same sense of blending nature and human, however, the way to achieve the balance is to invite nature into the human world by creating a void in the solid wall and buildings, nature is in the yard, with a blurred boundary between the solid houses on the four sides. In contrast, Japanese culture tends to human space should be part of the nature by blending it with it with ambiguous boundary.
Using Ashihara’s conceptual framework as a basis, the massive and constant use of wall through various scales in China indicates a strong Wall-oriented spatial conception. With a stronger emphasis on the creation of vertical space, it cultivates a more three-dimensional sense of enclosure by using the walls for separation, protection, and control. On the other side, Japanese spatial conception focuses on the floor as a two-dimensional layering process that blurs the concept of boundary and creates more flexibility and fluidity in space.

Unlike in the West, where the wall has traditionally been seen as the primary and linear element in spatial conception and composition (Shelton 2012), in China, it has been adjunct to a spatial conception that is primarily Areal and rectilinear in nature. In Japan, the wall has traditionally been even less important with an even greater emphasis on the area and the floor (Ashihara 1989 and Shelton 1999). This subtle difference of the Areal conception contributes to the creation of the different levels of spatial enclosure: a more closed arrangement exists in China compared to a relatively open one in Japan.

The wall and floor oriented differences that resulted from Chinese and Japanese cultures also infer strongly the creation of different forms and structures. A self-similarity and fractal repetition\textsuperscript{24} quality of Chinese and Japanese cities can also show the consistent influence under the wall and floor oriented spatial conception. The different understanding and methods of creating spatial containment and composition in China and Japan represent themselves by taking various forms at various scales reflecting their wider cultures and social structures: from the Chinese courtyard compounds and Japanese Machi\textsuperscript{25} at block scale, to Chinese walled residential superblock (Lifang) and Japanese water-bounded superblock at regional scale, and to the Chinese walled city and Japanese un-walled city at city scale (see Figures 2.26 on the next page).

\textsuperscript{24} see Chapter Three, the discussion of Salingaros’s study.

\textsuperscript{25} Machi usually refers to a number of blocks forming a commercial district or a city or town.
Figure 2.26 – The Fractal Repetition of the Wall and Floor at Different Scales (by author)
2.3 Historical Change of Supergrid and Superblock Structure in China and Japan

As discussed in the previous section, culture had a huge influence on spatial conception, which further shapes the way cities are designed and constructed. In the arena of Areal thinking, both China and Japan nurture a multi-dimensional and multi-directional spatial conception that is responsible for the creation of a Supergrid network at the city scale. The wall and floor spatial orientations further generate different types of Superblock structures that are responsible for the different morphologies in Chinese and Japanese cities. With the experience of different processes of change in the two places, the Supergrid and Superblock structures have evolved into relatively closed systems in contemporary Chinese cities, when compared with more open systems in Japan (See Figure 2.27). This can be clearly traced in the evolution of city structure as discussed in the following section and illustrated timeline diagram.

![Timeline of Superblock Structure](image)

Figure 2.27 – Timeline of Superblock Structure - showing models used in China, Japan and the West from Ancient to Modern Times (by author)

2.3.1 The Origin of the Supergrid and Superblock Structure in the East:

The Supergrid and Superblock were firstly proposed in the *Kao Gong Ji* in 2BC in China as an ideal paradigm of city planning. Two major spatial practices that predate this proposal were theorized as major design principles for a city in this book: the ‘well-and-
field’ land subdivision system and the Lifang system. They are commonly considered as the origins of the checkerboard layout of land subdivision and walled residential management system (Wu 1999). They also resonate with the multi-dimensional and directional Areal thinking and wall-oriented spatial conception in China as discussed above.

*Kao Gong Ji* demonstrates the principles of the city making from city scale to the standards of residential houses. The most important part is the proposed idea of creating a city with a Supergrid and Superblock structure that is bounded by wall and gates. As widely quoted from the book: ‘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’ . It means that a city should be as big as nine *Li* (1 *Li* is a square with each side approx. 510m in length) and enclosed by walls with three gates on each side (see Figure 2.28). The city should be subdivided with three north-south and east-west roads, which connect each gate as arterial (global) roads forming nine Superblocks. In other words, a Supergrid and Superblock structure can only exist, when global roads are connected between gates of a wall structure. Moreover, it was also used as a tool for spatial planning and social control that ties a social hierarchical classification with a land subdivision system. Each Superblock can be used for different urban functions (such as a palace, a residential quarter or a market). They are entitled with the etiquette system and embedded with the law and social morality to give the design of cities a certain philosophical and social meaning by positioning different parts at specific locations to each other. This model was not only widely accepted as the ideal city model within China, it also had a huge influence on its neighboring countries in the East Asia region, especially ancient Japan and Korea in their city design and planning of major capitals.

![Figure 2.28 – The Classical Model in Kaogongji (left, Steinhardt 1990, p.34); A diagrammatical interpretation of the ideal Chinese planning model (right, by author based on Liu 1936, p.575)](image_url)
2.3.2 Transformation in China: From Closed to Open to Closed System

Under the influence of culture and spatial conception, the Supergrid and Superblock structure in China has had different names in different periods\(^{26}\) and experienced an intermittent process of changing form from a closed to a relatively open and back to a closed system due to the shift of political power, social order and development of economy (Zheng 2016, Liu & Li 2009 & Li 2007). The Supergrid system as a major city skeleton has been used continuously to form the major road network both in the ancient and modern times, whereas the Superblocks have changed from a walled structure to less walled and more street-oriented structure and back to a walled structure as observed in modern cities.

2.3.2.1 The Formation of a Close Supergrid System and Walled Superblocks
The first application of the Supergrid and Superblock structure from *Kao Gong Ji* was in the construction of the city of Chang’an in the Han Dynasty. This planning model was absorbed into the design of the city of Ye in Caowei Dynasty, practiced as a systematic urban structure in the design of the city of Ping in Beiwei Dynasty and further developed in the city of Luoyang. Finally, in Sui and Tang Dynasty, this model reached a peak and mature state in its application to the well-known city of Chang’an in 6th century BC (Wang 2014a), which formulated ‘a classical planning model, prescribing a grand, centric, Confucian order’ (Zhu 2004). In the process, the Superblocks in the Supergrid system of those walled cities were designed and divided to have a number of identifiable communities as walled Superblocks. The use of the walls around cities and Superblocks in structuring cities became more unified and systematic. Moreover, they were not only given more symbolic and political meaning to represent ‘law and order’ (Steinhardt 1990) but also used as a device to manage and control social security and movement by creating a number of closed systems (Wang 2014a & Zheng & Li 2007). The orientation of cities changed too from facing east to facing south, and street networks (typical layout is cross streets plus laneways and cul-de-sacs) also became more symmetrical and regular within each Superblock (Shi 2005) because of the change of the orientation of buildings and cities from the Han to Tang Dynasty (Zhao 2013, and see Figure 2.29).

\(^{26}\) The Superblock Structure was called *Lifang, Xiangfang, and Shifang* in preceding times.
2.3.2.2 From Closed to Open Supergrid System: From Wall to Street Oriented

In Song Dynasty, the morphology of this structure transformed from a closed to a semi-open system because of the development of a market economy. However, while the walled Superblock structure was in decline and end (Heng 1999 & Friedmann 2005), the walls around cities and courtyard compounds were left largely intact. As a result, a Supergrid still mostly remained to connect between gates, creating Superblocks with a cross street plus laneway street layout as inherited from Tang Dynasty. This allowed businesses to open directly towards streets. Typical cities are Kaifeng, Bianliang, Luoyang, Nanjing, Hangzhou and many cities in the southern part of China. The famous painting *Qingmingshanghetu* illustrates the city of Bianliang at that time, and it is clearly seen that streets are used as public space and freed from the restriction of the wall structure around Superblocks (see Figure 2.30)
In the Yuan, Ming, and Qing dynasties, a Supergrid can still be found in many cities, as cities became more street-oriented with smaller streets linking the major wide roads to the residential courtyards like a fishbone structure. The orientation of buildings based on the south-facing building principle meant that the Supergrid network contained more north-south Global roads and smaller streets running in an east-west direction (see Figure 2.31). However, even though the walled Superblock structure was gone, some forms of the walled compound within each Superblock started to form again. Many parts of the city had a number of walled spaces with fences and gates to demarcate the boundary of certain properties or groups of people, and the level of openness started to decline again. Thus, the system was not an open system as in the Song dynasty, but relatively opened only at some level.

2.3.2.3 From Open to Closed Supergrid: Superblocks with Walled Structure

In modern times, the Supergrid and Superblock structure came under four stages of Western influence: experimentation with the neighborhood unit concept from America from the 1920s to the 1940s (Lu 2005 & Ren 2008); introduction of the Russian company town and microdistrict models and the formation of Danwei system in the period from the 1950s to 1970s (Rowe, Lu & Zhang 2001, Bray 2005, Hartog 2010); the application of comprehensive traffic planning and Milton Keynes type of Superblock in 1980s (Shane 2014); and the implementation of the American type of gated community since the 1990s (Liu & Li 2010). Nevertheless, despite the Western influence, the structure maintained a clear Chinese style from three aspects. Firstly, the Supergrid is
used as the overarching and hierarchical structure with a limited application of the small grid and radial road structure\textsuperscript{27}; many pre-modern Global roads that connected between gates in the demolished city walls were preserved and often reused as the skeleton of modern Supergrids. Secondly, the introduction of Western planning ideas is mostly related to the modern Western Superblock model. Thirdly, all Western models were adapted with a special Chinese twist: they were eventually walled in order to declare the property ownership and enhance levels of security (Lu 2006), and they are called *Xiaoqu* or gated communities (see Figure 2.32).

![Figure 2.32 - A Walled Danwei, Plan for Xiefang Production Team, Suicheng People's Commune, Henan, 1958. (Adapted by Author from Lu 2006, p.110)](image)

Thus again, the wall structure is used pervasively in combination with western Superblock models and the major structure of cities becomes that of Superblocks; and the street layouts within each superblock of this Supergrid becomes a closed system with culs-de-sac. This particular transformation of the city morphology has given a very special characteristic of the modern Chinese Superblock structure and it is the key that decides the level of openness and performance of the urban Supergrid and Superblock structure in contemporary China (see Figure 2.33). The social structure persists with walled communities acting as self-contained units within Superblocks, indicating that strong social value is attached to this kind of Superblock structure.

\textsuperscript{27} Small grid can create triangular shape which is forbidden in Chinese planning according to culture and fengshui. Small grid structure can normally be found in some commercial area in Chinese cities.
In general, the Superblock structure changed from a walled compound to that of a more open and relatively integrated part of a Supergrid city structure only to change back to a structure of isolated cells. In this process, a Supergrid remained, but Superblock structures were transformed from walled single use areas in the Tang to mix use functional areas without walls and gates, where shops and stalls proliferated along the streets and a real urban street life was generated, in the Song, Yuan, Ming and Qing Dynasties (Kato 1991, Skinner 1998, Heng 1999, Li 2005, Li 2007, Lai & Liu 2008, Zheng & Rao 2012, Liu 2013, Yao 2014, Liu & Ge 2014). The street networks also changed from a cross street pattern in the Tang and Song Dynasties to a fishbone or tree with cul-de-sacs in the period from the Yuan to Qing Dynasties. They have since been changing to the ‘towers-in-the-park’ type tree structures with walls as the dominant morphology in contemporary Chinese cities (Monson 2008). The transformation of Chinese superblock is as Friedmann (2005) states: China went ‘backward into the Future’ (p.117).

2.3.3 Development in Japan: From Closed to Semi-Close and to Open System

Ancient Japanese city planning was heavily influenced by planning methods of the Chinese (Hiroyuki & Kaneko 2005 and Sekiyama 2010), and the Supergrid and Superblock structure is one of the most important planning norms that have been introduced to Japan. However, when compared with China, the Supergrid and Superblock structure in Japan was not used consistently through history. When it has been used, it has transformed from a semi-closed system with multiple fenced areas in ancient cities to an open system in modern cities.
2.3.3.1 From Closed to Semi-closed System

The Chinese Supergrid and Superblock model was applied in the design of four oldest ancient Japanese capital cities: *Fujiwara-Kei, Heijo-Kyo, Nagaoka-Kyo* and *Heian-Kyo* (Takahashi et al. 1993 & Wang 2007). However, it was gradually adapted as a ‘Jo (rows) - Bo (column) – sei’ planning system, which specifies every area in the city by a set of row and column number. This system, containing a network of ‘Big roads and Small streets’, is a Japanese adapted version of the Chinese Supergrid and Superblock structure (see Figure 2.34). The transformation of the adopted Chinese Superblock model underwent three major morphological changes in order to be more suitable to the Japanese context: 1) the first change is the abandonment of the wall and gate structure; 2) the city design process changed from ‘whole to part’ to ‘part to whole’; and 3) street network within each Superblock changed from a Chinese cross street pattern with different block sizes to a matrix of 4-by-4 smaller street blocks of equal size (120m squares). In this process, the Japanese Superblock became a semi-closed system rather than a closed system. The use of wooden gates and fences were also used to demarcate space in Superblocks rather than using heavy brick walls around Superblocks. As a result, a better structure for movement and traffic was formed resulting from the design changes (Shi 2005 and Wang 2007).

![Supergrid and Superblock structure](image)

Figure 2.34 – Supergrid and Superblock structure that was adapted from the Chinese Model (left, by Author, Based on Takahashi et al. 1993, p.50-51; right, Uenishi 2009, p.35)

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28 Although the traces of the short walls were found in the first two Japanese capitals, they were totally ditched in the subsequent two cities for practical reasons (Taichi 1996, Wang 2007).

29 See footnote 18 on page 27
2.3.3.2 Co-existence of a Closed and a Semi-closed System

However, during the Kamakura, Muromachi and Azuchi-Momoyama periods, this Supergrid and Superblock structure was mostly destroyed by the gradual erosion of wide roads and replaced by the Machi or Cho type of street block structure with irregular narrow streets (Takahashi et al. 1993). The medieval time in Japan was a period of chaos. There was a lack of dominant political power over the whole country, and therefore, cities mostly grew out of an organic process without much planning (ibid.). Later, in the time between the Sengoku and Edo periods, a warring period with all kinds of social upheaval and political turmoil, there was a new type of city gradually forming: the castle town. As an indigenous urban structure that is characterized by asymmetry and irregularity, it provides the fundamental basis of modern Japanese cities (Sorensen 2011) and also laid out the foundation of Japanese city structure with an inbuilt ‘oku’ as appreciated by Maki.

Before the fully mature castle towns, most of the cities were in a Japanese Machi/ street block structure\(^{30}\) without an overarching Supergrid. They were laid out based on the ranking of social status from the Chinese Confucianism: The higher ranked vassals and samurai were located next to a castle, whereas lowered ranked commoners like merchants, artisans were located on the outer range or along major roads (such as the Suzaku Oji). Temples and shrines were located even further away on the urban fringe (Sorensen 2011, p.22-23).

When Castle towns were fully built up in the Tokugawa period, most of them had water channel systems that divided the towns into a number Superblocks bounded by water (see Figure 2.35). Each of these Superblocks contained a Machi structure that is connected to other parts of cities by canals and bridges and some of them are also used as commercial and entertainment districts, as in Edo (Naito & Hozumi 2003), Osaka and other major Japanese cities. However, their formations were not within a Supergrid network of roads, but rather products of land subdivision within a system of water channels\(^{31}\).

\(^{30}\) A network regular grid and square blocks that are firstly used in the ancient Nara and Kyoto as a spatial tool for land subdivision
\(^{31}\) Edo was designed to have some individual Superblocks that were formed under a centripetal city structure that spirals out from the Castle Center. Osaka had a relatively regular water network but it’s not based on a Supergrid as a whole
Although castle towns were also made for social segregation and defensive purposes by having walls, fences, and gates, they are firstly not around any water Superblocks or around the whole city, but only around the residences of the Lords and daimyos; and secondly fences and gates were set as road barricades that control the access of people with much lighter and more flexible physical structure compared to Chinese walled Superblocks. In other words, the city as a whole was still an un-walled semi-open system. Moreover, even though the Chinese Imperial Supergrid was not adopted, the water channel in some sense acted for the same idea of having different social class congregating in different parts of the city around the walled castle based on the social status. In some sense, the spatial structure of the indigenous Japanese castle towns resembles the same idea of the Chinese Lifang or Japanese Jobosei system, and this, to some extent, can explain the reoccurrence of the Supergrid-and-block in the modern period.

Just as Sorensen (2011) states that castle towns have a profound influence on the modern Japanese structure, it is important to recognize that they also have a large impact on the formation of the modern Supergrid and Superblocks. The water channels often laid out the foundations for modern transportation. Many of them were later transformed into wide roads to accommodate trams and cars. Therefore, this thesis would argue that even though the Supergrid did not exist in this period of time, the Areal thinking underpinning the Supergrid was still used in the spatial organization. Moreover, it reflects the Japanese sense of spatial structure by having water channels as symbolic boundaries for creating a more organic structure of cities.
2.3.3.3 From Semi-closed to Open System

The Supergrid and Superblock structure reappeared as an open system in the Meiji period (see Figure 2.36). The formation of an actual Supergrid-Superblock structure, as Shelton 2012 states, is usually the result of modern Eastern planning practices (partly under Western influences), such as road widening, land readjustment, and height control according to the 'slope plane'\(^{32}\). These affect the design of Japanese cities today and create the 'Hard-shell and Soft-yolk'\(^{33}\) type of Superblock in contemporary Japanese cities (see Figure 2.37 and Figure 2.45).

The first embryonic Supergrid network appeared during late 19\(^{th}\) to early 20\(^{th}\) century. The introduction of new forms of western technology and transportation, such as train, tram, and cars boosted the need for city transformation (Sorensen 2001). Tram networks were constructed in many major Japanese cities. These created a network of gridded wide roads, which were later converted into Global wide roads to accommodate automobiles. Many new Global roads were then constructed to extend this network base into the wider city area as a grid or deformed grid network. Cities like Kyoto, Osaka, and Nagoya are typical examples of this process. The second type of formation of the Supergrid and Superblock structure can also be found as a result of land readjustment. The city of Nagoya and the Tokyo earthquake reconstruction are examples of the formation of this kind of Supergrid and Superblock structure (Maki 2015, see Figure

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\(^{32}\) Slope Plane: It has been a fundamental component in determining building form since 1919. The concept is to create a building envelope that is defined by the width of street to allow light into street and buildings accordingly, the wider the street, the higher the building. It is also determined by the use of land: 1:1.5 and 1:1.25 in a horizontal-to-vertical side ratio above a certain wall height in commercial and residential areas respectively - see Figure 2.37. (Shelton 2012)

\(^{33}\) For the explanation of the 'Hard-shell and Soft-yolk', see explanation and Figure 48 on Page 21.
2.38). In this process, the reappearance of this structure through superimposition of a new grid on top of the existing small grid structure creates an open system that intends to link different parts of cities with minimal obstruction to the connection for movements.

![Figure 2.38 - Plans for Reconstruction after the Great Earthquake in 1945 (Yasuo 1986, p.31)](image)

Overall, it is clear that the evolution of the Japanese version of Supergrid and Superblock structure differentiated them from that of the Chinese with a stronger water-related culture (Jinnai 1995 and Osamu 2006) and a relatively more connected and flexible urban system (see Figure 39). Although the Supergrid and Superblock structure was not always used throughout the history, the underpinning organizational principle of creating a multi-directional structure was underpinned in various transformations. More importantly, because of the limited use of wall and strong boundary under the floor oriented spatial conception, the structure in Japan evolves from a closed to a semi-open and to an open system.

The evolution of the structure in the two countries clearly reflects how the wall and floor-oriented spatial conceptions had profound influences on the formation of Chinese and Japanese Supergrid and Superblock structures and lead to the relatively closed and open urban systems in their modern cities (see Figure 2.39). The contemporary Supergrids and Superblocks in Chinese and Japanese cities are different from those in the ancient version. However, notwithstanding the introduction of western planning concepts and ideas into China and Japan, the fundamental principles of city-creation are still unshakably cultural.
2.4. The Contemporary Condition of Superblock

Against this cultural and historical appreciation of background, it is also important to focus on what the structure is like today, how it works and how it affects contemporary Chinese and Japanese life. While the modern cities of both countries are expected to be centers of economic production that can provide synergetic activities and convenient life, the structures as closed and open systems have different impacts on the operation of modern Chinese and Japanese cities. The following section discusses the existing studies of this modern structure in both countries sourcing from studies in Chinese, Japanese and English.

2.4.1. In China: Fragmentation, Disconnection, and Isolation

The structure of contemporary Chinese cities is largely a net-and-cell structure of a Supergrid and Superblocks (Zhao 2008, Xu & Yang 2009 a,b). It is clearly indicated in
the national standard of the road and street system in Chinese planning textbook and planning regulation as discussed earlier in this chapter. As discussed before, cities are to be covered by a hierarchical road network with global road intervals that lie between 750m-1200m depending on the size of a city, which means a Supergrid network. In each cell of the Supergrid, there may be different combinations of housing types (see Figure 2.40).

![Figure 2.40 – A Gated Community as a Superblock (Adapted from 'Wuhan' 2015, left); and Several Gated Communities as a Superblock (Adapted from 'Zhulong' 2006)](image)

More than 80% are of the gated community type (Wang 2003) and an increasing number of these are built at the Superblock scale (Zhao and Hu 2008). Monson 2008 claims that superblocks represent the DNA of contemporary Chinese cities; as elements of the Supergrid, they construct the foundation for traffic networks, property transactions, and urban expansion, and also reflect collectivism and communism in the culture of contemporary China. With increasing interest and more studies of the superblock phenomenon (Frank Jr. 2006), many authors of existing studies point out those Chinese cities are tending to become more fragmented, disconnected and isolated (see Figure 2.40 & 2.41). They also emphasize the problems and the need to rethink the existing urban morphology.

At least five studies directly review the problem of Supergrid and Superblock. Zhao (2008), as the most comprehensive study of the Supergrid-Superblock structure, concludes that both the traditional and modern Chinese Supergrids and Superblocks are problematic because of the lack of effective road planning and land subdivision. He recommends adopting the Western smaller street block model with more subdivision of existing Superblocks. Zhao (2006) and Xu and Yang (2009b) also claim that Superblocks are problematic because of their lack of connectivity and properly sized land
subdivision. Further, Zhao (2002) investigates the negative economic impacts of the
Chinese Supergrid. Monson (2008) discerns that the Superblocks in Chinese cities have
created a disconnected fabric and the internal streets usually form closed loops.

At least twenty-three studies review the Superblock structure indirectly. They study the
gated community and claim that gated communities have created barriers to existing
road networks and pedestrian movement. Street block and Superblock types of gated
communities are both discussed. Among the twenty-three studies, at least four directly
point out that the gated community at a Superblock scale can create disconnection
problems in cities (see Figure 2.42). Xu and Yang (2009a, b) assert that this type of
Superblock is detrimental to China’s urban environment because they have very limited
connections to the surrounding areas and wider city network. Wang (2010) and
Niemininen (2012) claim that one of the major problems of the Chinese Superblock
structure is the missing connection between the inside and outside of residential
superblocks because of fences and walls acting as major barriers. On another aspect, 25
studies over a 13 year period34 criticize the gated communities at block scale (see figure
2.42) from urban planning perspectives: they regard the gated community as a source
of social, economic and environmental problems by creating barriers and isolating
movement.

Li and Li (2007), Xu & Yang (2008a, b), Yang & Min (2008), Liu & Li (2009), Song & Zhu (2009), Xu (2009), Xu et al. (2009), Liu & Li
Nieminens (2012) systematically reviews the gated community at block scale and suggests a solution by introducing the western small grid structure into the Superblocks. He claims that the current Superblock structure is not a sustainable model for city development and it endangers the Chinese urban environment. He asserts that these Superblocks tend to fragment cities, creating single use isolated cells by minimizing the connections between the inner Superblock and the wider city environment. He also shows that the streets inside of the Superblocks are mostly closed loops and dead ends (see Figure 2.41 and 2.42) and claims that the Superblocks need more subdivision of the land to create more streets for better connections. Similarly, Wang 2012 also remarks that the Supergrids of Chinese cities lack proper subdivisions and this has created many disconnections in the city.

Following such criticism, a wall-demolishing policy emerged from the government at the beginning of 2016 and this clearly indicates national concerns about connection and transportation problems resulting from the wall structure (MOHURD 2016). However, the actual implementation of this policy has been widely resisted by the people as discussed before. As a result, the actual influence of this policy is very limited. To some extent, this policy is against the cultural and social order that has been discussed in the first section of this chapter, and it does not really bring satisfactory solutions to solving the urban problems raised by many academic studies. This raises the importance and urgency of the understanding of the modern structure in Chinese cities.
In general, the Superblocks as discussed by the existing studies imply a structural issue that obstructs movement and activities, which have in turn caused a number of urban problems and social issues. This indicates a need to further study the morphology of contemporary Chinese cities and its associated problems (see Figure 2.43).

![Figure 2.43 – Logic of the discussion from existing studies of Chinese Cities (by Author)](image)

2.4.2. In Japan: Diversity, Vitality, and Convenience

Shelton (2012) states that ‘the superblock structure is the sine qua non of Japanese urban design – attempted time and again wherever space and circumstances have allowed’. (p.141) Although there are very limited studies of the Supergrid and Superblock structure in Japanese cities, the existing studies suggest a positive role of it in creating more diverse, convenient and vibrant environments, assisting in the integration of the city as a whole (see Figure 2.44).
Ashihara (1983 & 1989) discerned that the hidden order of the Japanese cities follows from a design and planning process that usually starts from the part and moves to the whole, indicating piecemeal fashion design and much attention to small-scale and details. He thinks that these characteristics are crucial for the design of a lively and convenient city environment and they are part of the cultural influence, especially from the floor-oriented spatial conception. He also writes that an amoeboid quality in Japanese cities gives an advantage of being able to expand endlessly.

Kurokawa (1994), on the other hand, claims that symbiosis is also an important characteristic of Japanese culture and cities. It allows the juxtaposition of different things together and incorporates opposing elements (p.29). Although he doesn’t directly relate this idea to the creation of urban structure, he does think that the concept of symbiosis and Japanese cities are good representations of the concept of Rhizome, as proposed and defined by Deleuze and Guattari (1980): ‘an open system’ (p.32) with multiple and non-hierarchical connections and links. It emphasizes the importance of multiplicity and interconnection between different things.

These characteristics of the Japanese cities are also noted by a number of Japanese commentators. Jinnai (1994) and Watanabe (1985, p.272-6) compliment the positive consequences of the high degree of mixed use in Japanese cities. Similarly, Fujita and Hill (1997) comment that Japanese urban areas have avoided the high degree of residential segregation that is prevalent in the US and includes residents with a wide
range of income in close proximity. Hohn (2000, p.548) states that: ‘……urban space in Japan has thus primarily positive connotations, for this guarantees variety, liveliness, color, variability and contrast with simultaneous integration in a common network which makes for cohesion. The key to success lies in the inclusive philosophy of flexible direction, in the general openness of town planning to new ideas and stimuli’.

Sorensen (2011) also compliments the value of the inclusive and flexible nature of Japanese urbanism and its highly mixed use of land. He claims that extensive areas of Japanese cities have a structure with integrated mixed use, medium-to-high residential densities and high levels of public transport service after receiving a series of planning interventions and experimentations since the Meiji Period.

Hein (2008) discusses the Japanese idea of neighborhood and comments that the Japanese cities are ‘densely built, functionally-and socially-mixed residential areas with shopping streets, educational facilities and public transportation within walking distance, and feature narrow and irregular paths that require cars to drive carefully and allows room for neighborly talk and children’s play’ (p.11). She thinks that there is a special quality to the Japanese neighborhood (Machi), its social and functional diversity.

Similarly, this Supergrid and Superblock structure is also captured and repeatedly discussed by Tsukamoto in his several studies. Even though he didn’t use the term ‘Superblock’ as used by Shelton (2012), he gives a very good depiction of the structure: a clear contrast between ‘wide avenues’, modern ‘high-rise buildings’, ‘large stations’ and ‘a dense pattern of single family houses, small apartment blocks and gardens, integrated in a fine network of services that tend to concentrate around a commercial street (Shotengai) with small businesses, eateries, artisans and services to the community’ along a network of narrow streets (Tsukamoto and Almazán 2006, p.3; Kitayama, Tsukamoto & Nishizawa 2010, p.29, & Tsukamoto & Fujimura 2007). While the global infrastructure is considered as a form of western influence, he claims that the mixed used residential area reflects a ‘deeply rooted feature of Japanese lifestyle’. All of these together generate a unique character for Japanese identity that cannot be found in the western cities. More specifically, Mohr (2007) further points out that many contemporary observers view Japanese cities as a model for the future and an
inspiration for urban planning. This implies a need to understand Japanese urban structure and discover what crucial elements for creating such a good environment really are.

Shelton (2012) is the first (and may be the only) study of the Supergrid and Superblock structure in contemporary Japanese cities so far. He argues that the superblock is an important urban spatial structure that can encourage and facilitate many of the qualities of Japanese cities that have been discussed by the people above. Endorsed by Maki (2015), this is an embryonic but significant study providing a fundamental understanding of the structure and some guidance to this research. Shelton’s observation of the city of Nagoya reveals a unique urban structure: ‘Hard shell/ big roads flanked by higher buildings and more intricate ‘Soft yolk/small street’ networks within where lower buildings sit within the larger grid to form a superblock (p.141)’ (see Figure 2.45). This was started by the superimposition of a modern Supergrid of big roads upon a pre-existing small grid of narrow streets that formed Nagoya castle town.

![Figure 2.45 - The 'Hard Shell-Soft Yolk' form of a Japanese superblock in Tokyo (by Author)](image)

More importantly, he also discovers that the distribution of activities is both concentrated at the intersection of major roads and along their edges and scattered across the whole Superblock area (see Figure 2.46). Shelton 2012 also shows several potential analytical methods to understand how this structure affects movement and activity patterns in cities (see Chapter 4). Some diagrams and maps provided technical precedents for this study. He also points out that Kyoto has a similar Superblock structure, but those Superblocks have undergone a different process of formation because of the ancient adoption of the Chinese Supergrid and Superblock model. This implies a potential for different types of Superblock in Japan, which is investigated in Chapter Six.
Shelton (2012) also indicates that this Japanese Superblock structure has influenced cities in other parts of East Asia where Chinese written characters are used, like Taiwan. Wang's Taipei study (1996) confirmed this speculation. She discovered a similar Superblock structure of higher density where there were strong Chinese and Japanese influences on its city development. However, Taipei will not be studied further in this research since Wang 1996 has already made a comprehensive morphological study of the Superblock, but it will be a good reference for this research, especially for understanding the combination of Chinese and Japanese cultural forms.

Several collaborative studios between students of Melbourne and Nagoya Universities investigated Superblocks in the city of Nagoya between 2011 and 2013. These made a number of discoveries about Japanese Superblocks, which possess well-connected structures that can contribute to the active and synergetic environment discussed by the academics quoted above.

In general, the emerging association between the positive qualities of the Japanese urban environment and limited studies of Superblock structure signals a potentially rewarding area for further study. As the first developed country in Asia, Japan will provide promising precedents for neighboring countries of the same cultural block.

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35 Japan was a major influence on Taiwanese modern city planning during its occupation of Taiwan in the early Twentieth Century.
2.5 Summary

This Chapter reviews existing studies that are relevant to the Supergrid and Superblock structure in an Eastern cultural context to answer three questions:

1) How does culture affect the formation of Supergrid and Superblock urban structures?
2) How have these structures in Chinese and Japanese cities transformed through history?
3) What are the contemporary characteristics of these structures?

The first part of this chapter answers the first question through the investigation of existing studies that discuss culture, space, and urban form. While cities are made of collections of buildings and space with certain configurational arrangements created by different cultures, the Supergrid and Superblock structure is also formed under a strong Eastern cultural context. It is interpreted differently in form and structure according to the cultural similarities and differences in China and Japan. While both of them are formed under the Areal thinking nurturing a multi-dimensional (Isozaki) and multi-directional (Shelton) spatial conception, China is more wall-oriented and Japan is more floor-oriented (Ashihara). As a result, the multi-dimensional and Multi-directional Areal spatial conception are responsible for the multi-directional Supergrid as a common overarching global network, while the wall and floor oriented spatial conceptions contribute respectively to different spatial structures within Chinese and Japanese Superblocks. They are arguably the generic approach to space and spatial design behind Chinese and Japanese cities that underpin the cultural discourse.

This second part of the chapter reviews the changes of Chinese and Japanese superblock structures through history that lead to the formation of Chinese closed and Japanese open systems in contemporary cities because of cultural differences. The study shows that even with substantial influences from modern western planning ideas and methods, the design and construction of Chinese and Japanese cities are still strongly affected by their own common and individual cultures and the same ancient planning model. In other words, the Eastern Super grid-and-block structure is a modernized incarnation of a fundamental Chinese and Japanese social structure and cultural conception of space.
While the modern version of the Supergrid and Superblock structure is barely discussed in the Chinese and Japanese planning system, the regulations from both countries indicate the use of the structure as part of their planning norms. Although the form and function of the modern structure are different from the ancient one, there is in its evolution a persistent use of this culturally represented, codified and utilized spatial structure has withstood the collision of planning ideas from the west.

Lastly, this chapter reviews existing literature that has studied contemporary Chinese and Japanese superblock structures: this also indicates the relative advantages and disadvantages of Chinese and Japanese superblock structures. Existing studies from China indicate a strong recognition of the structure and the problems that are caused by the wall structure, while studies and recognition of the equivalent Japanese structures are rather limited. While the urban structure and associated issues in China are getting more and more criticized, Japanese cities are praised for their structural advantages and potential as a role model. In order to understand the Supergrid and Superblock structure in both countries, and how the functional operations of these culture-related morphologies support or create problems in cities, this thesis analyzed and discussed them according to the theoretical and empirical work of the selected group of scholars and writers outlined in the next section.

End of Chapter Two
Chapter Three
Theoretical Basis
3.1. Introduction:

‘Thinking has its strategies and tactics too, much as other forms of action have. Merely to think about cities and get somewhere, one of the main things to know is what kind of problem cities pose, for all problems cannot be thought about in the same way. Which avenues of thinking are apt to be useful and to help yield the truth depends not on how we might prefer to think about a subject, but rather on the inherent nature of the subject itself’.  

------------------------ Jacobs 1962, p.442

Cities present two sets of important features through their spatial structures. One is generated by the sociocultural life at a local scale displaying differences, and the other is generated by economic life at a global scale demonstrating similarities as the generic function\(^1\) of cities (Hillier 2001, p.10)\(^2\). Cities in the past were also centers of the economy, but socio-cultural-political forces were given higher priorities in their constructions, as discussed in the previous chapter. Buildings and spaces are often disposed in a range of specific sequences, patterns, and configurations to reflect the social, cultural, political rules (Hillier 1996) and to satisfy ‘certain needs expressed by different forces’ (Doxiadis 1968, p.288). Consequently, spatial structures were deployed to obstruct certain connectivity and urban mixing (e.g. by gates and walls), and levels of social encounter, economic development and convenience of living were sacrificed.

Nevertheless, such understanding of cities as political and religious oriented centers in ancient times has shifted. In the late 19\(^{th}\) Century, cities came to be seen ‘as works of art’ with an emphasis on aesthetics. This is followed by a more function dominated view that prevailed with the idea of conceiving cities ‘as machines’ in the Modern era. A further change occurred in the 1960s with the

\(^1\) Modern cities present a common ‘generic function’, by which Hillier fathoms: ‘it is the spatial implications of the most fundamental aspects of human use of space that is the fact of occupation and the fact of movement. At this generic level, function imposes restraints on what is spatially viable, and this is responsible for what all buildings have in common as spatial designs (Hillier 1996 p. 8)’.

\(^2\) The concept of ‘spatial culture’ refers to different spatial configurations that are created by different cultures. He thinks that culture was the major force that creates the urban grids in the pre-modern cities. However, he also points out that when economic development is the priority of all modern cities, spatial structures present a very interesting structure: the impact of culture as a variable ‘mainly puts its imprint on the local texturing of space, generating its characteristic differences, whereas micro-economics is a constant and puts its imprint mainly on the emerging global structure of the settlement in a more or less invariant way. (Hillier 2001, p.6)
city increasingly seen as a textual and experiential phenomenon (or city as text) – a reaction to the clinical functionalism of Modernism. This was, in turn, superseded by New Urbanism, which sees cities as sources of wealth and places for synergetic and convenient lifestyles. (Shelton 1986, Marshall 2009, Chapter 5 & Marshall 2011a, p.139) Under these shifts of the paradigm of what an ideal city should be, the avenues of thinking about the principles of creating good urban structures have also changed. As a result, cities become ‘palimpsests that emerge from multiple layers of creativity, erasure, history, politics, economics and technical invention’ (Dovey 2016, p.14).

While socio-cultural influence was an underlying power that configured urban morphology in the past, it is not the fundamental force that supports the operation of a city in the contemporary era (Hillier 2001). The homogeneity and commercialization of contemporary cities through globalization has oriented cities to serve their new ultimate function: wealth production, which requires a well-connected urban structure to exchange goods and information; and it has never been so amplified as in the present times. However, not all cities are equally productive. As indicated in the previous chapter, modern Chinese cities have encountered a series of urban problems, while Japanese cities seem to present good examples in terms of economic productivity without sacrificing quality and comfort of their urban environment. Therefore, a theoretical framework is built in this chapter based on such contemporary ideas of a good city in order to understand how the physical form of the urban structure affects the functional use of space in Chinese and Japanese cities. Chapter two reveals cultural, historical and programmatic prerequisites of the Supergrid and Superblock structure. This chapter sets out the theoretical basis of this thesis through an understanding of how urban structures work to facilitate or impede the modern functioning of cities based on a group of studies discussed below.
3.2. Structure-Movement-Activity Interplay: The Theory of Interconnection

Writing in 1961, Jacobs likened the Modernist machine based image of a city to that of 'a collection of separate life drawers' (Jacobs 1961, p.450). As a consequence, cities were made in the same way to isolate form and function by planners and designers based on a number of Modernist planning ideas and concepts (Hillier 1996). It followed that the socio-economic functions of cities suffered from the compartmentalization of structure, movement, and activities and inability to create urban synergies (Jacobs 1961, Hillier 1996, Marshall 2005 & 2009).

This kind of thinking has also led to the creation of Western Superblock propositions, which can be classified into three types (see Figure 3.1): 1) a Supergrid and Superblock structure is designed as one block-and-grid system in practice, such as Milton Keynes, Radburn, Chandigarh and Los Angeles³ (see Figure 3.1.1, 3.1.2); 2) the proposal of a Superblock as a theory or prototype, such as Corbusier's the city of tomorrow, Perry's Neighbourhood Unit and Doxiadis' ecological planning framework (see Figure 3.1.3, 3.1.4); and 3) advocacies of transforming cities into a number of Superblocks through traffic infrastructure by people like Buchanan’s ‘Traffic in Towns’. These modernist concepts also have had substantial influences on both China and Japan in their modern city planning (see Figure 3.1.5, 3.1.6). While China's experiments with these concepts have resulted in urban disintegration and a number of functional issues, Japanese planners have tended to adapt them, ‘adopting foreign techniques aimed at creating a more functional layout of the land as long as they allowed for small-scale piecemeal interventions' (Mohr 2007, p.10).

³ A few cities in Pakistan and Indian applied such structures as colonial experiments. The most famous one is the Chandigarh by le Corbusier. The Superblocks in Los Angeles were created as traffic safety improvements by separating different modes of travel.
3.1.1. Supergrid and Superblocks in Milton Keynes (Google Map 2017)
3.1.2. Radburn (Barba 2013)
3.1.3. 1922-1925 | Le Corbusier | Plan Voisin | Paris, France (Corbusier 1987)
3.1.4. Superblock in a city in Pakistan (Doxiadis 1968, p.360)
3.1.5. Superblock proposal by Traffic in Towns (Buchanan et al. 1963, p.42 & 44)
3.1.6. Neighborhood Unit by Clarence Perry (Ward 1992, p.11)
In other words, those modern planning and western Superblock practices are problematic in the West (Jacobs 1961 & Hillier 1996), and are not working well in some Eastern cities either. These modernist concepts not only reflect a linear spatial conception in the culture creating strong radial structures in cities (see Figure 3.2 and Chapter Two). They also mirror the ‘two-variable system of thinking and analyzing’ as criticized by Jacobs (1961, p.449) that naively considers cities as a number of isolated systems. Hence, a better ‘thinking strategy’ for designing cities is required as noted above.

Figure 3.2 Diagrams are showing Western Radial Models of City Structure in Modernist Design reflecting the Linear Spatial Conception. City structure Diagram from Traffic in town (top left), Ebenezer Howard’s vision of social cities (top middle), Copenhagen’s Five finger Planning model (top right), (Buchanan 1964, p.119 & Howard 1898, Danish Ministry of Environment 2015, p.5&19); On and off the street grid: Relative Distributions of Road Orientations (bottom four maps, Kadish 2014)

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*Jacobs uses this term to criticize to the traditional scientific approach that tries to solve urban problem as math equation with only two variables at a time.*
Arising from the critique of such Modernist understanding and reflections on traditional and modern cities since the 1960s, a number of studies, including Jacobs (1961), Alexander (1965), Hillier (1984 & 1996), Bentley et al. (1986), Deleuze and Guattari (1987), Gehl (1987 & 2010), Arida (2002), Salingaros (2005) and Marshall (2005 & 2009), are concerned with the interrelationships between built form (building and space) and function (movement and activity) in cities. They are framed collectively in this study as Interconnection Theory, which sets the theoretical and methodological base for this research. These studies note that an effective urban structure is needed to support the operation of a modern city, which should be able to provide and maximize good socio-economic performances (trade and exchange) and services by generating and facilitating functions like human movement and activities.

Although these studies have different theories and strategies, they all suit the contemporary social norms of a good urban structure that see the importance of movement and activities to generate urban synergies. Among these studies, the integration, connection and interaction can be summarized as the key principles for creating a good urban structure if it is to maintain trade and exchange through the generation and facilitation of movement and activities. This can further create synergies between social and economic activities that equate with Jacobs' (1961) 'organized complexity'. Without a well-designed physical form that provides connections for movement and facilitates interactions between different parts of cities and across multiple scales, problems will occur: ‘extreme compartmentalization and dissociation of internal elements of any organized object will lead to destruction’ (Alexander 1965, p.17).

The central ideas of the Interconnection Theory are threefold. These are: 1) cities are organized and complex systems that are mainly composed of interconnected physical and functional sub-systems through multiple links; 2) the interplay between street structure, movement and activities are the nuclei of the interconnection between form and function; 3) Integration, Connection and Interaction are the three fundamental principles that a well-functioning city structure needs to be able to generate socio-economic synergies.
3.2.1 Cities as Organized Complexity: Interrelationship between (Physical) Form and (Social) Function

‘Physically, cities are stocks of buildings linked by space and infrastructure. Functionally, they support economic, social, cultural and environmental processes. In effect, they are means-ends systems in which the means are physical and the ends are functional. Our most critical area of ignorance is about the relation of means to ends that is of the physical city to the functional city.’ (Hillier 1996, p.149)

Hillier’s description of cities reveals two important sub-systems of cities: the physical form as a means, and its attached social function as an end. They are two primary intertwined systems that were isolated in modernist planning, and were initially highly criticized by Jacobs. In her writing, the deterioration of the American urban environment through the application of Modernist movement principles in the 1950s prompted her observation of the interplay between physical form of cities and socio-functional performance. This interaction was depicted in her very influential and controversial book in 1961, *The Death and Life of the Great American Cities*, which lays the foundation stone for this group of Interconnection Theories and assists in understanding the work of those who follow her. The leitmotif of this book is the need to think of the cities as ‘organized complexity’, which is composed of a number of interrelated systems.

![Theoretical Basis: Interconnection Theory](image)

Figure 3.3 – Diagrams of the Interconnection Theory indicating the Complexity of Urban Systems
Because they present ‘situations in which a half-dozen or even several dozen quantities are all varying simultaneously or even several dozen quantities are all varying simultaneously and in subtly interconnected ways (p.452 & 446)’. Those interconnections, therefore, can create ‘street ballets’, which are results of the choreography between the form and functions of cities (see Figure 3.3).

Four years later, as an architect, who also understands mathematics, computer science, and transportation, Alexander was not satisfied with conventional modern architecture and planning. Influenced by Jacobs' idea of urban complexity, Alexander's ‘City is not a Tree’ (1965) proposes a semi-lattice structure against the tree-structure, which are both ‘ways of thinking about how a large collection of many small systems goes to make up a large and complex system’ (p.67). Alexander visualizes Jacobs' 'complexity' as a 'semi-lattice' structure, which indicates a ‘natural city’ with a number of interconnected systems that can stimulate rich interplay between activities at all scales to generate synergies (Figure 3.5). The semi-lattice axiom as Alexander explains is: ‘A collection of sets forms a semi-lattice if and only if, when two overlapping sets belong to the collection, then the set of elements common to both also belongs to the collection (p. 69).’ Alexander gives a highly detailed definition by arguing that, ‘if and only if, when two overlapping sets belong to the collection’. His criticism is that lack of such complexity can lead to the kind of dysfunctional design of modern ‘artificial cities’ that characterized the work of Le Corbusier, Hilberseimer, and other modernist planning disasters (Alexander 1977 & 1979).

These cities, which are created by a tree-like way of thinking, have tended to create tree-like street structures and reduce the vitality of cities by fragmenting cities into islands, isolating functions (zoning), and stripping the interconnections between the form and function of cities. This is the case in China, where thousands of urban design projects are transforming Chinese cities into artificial cities (Figure 3.4). In comparison, an interconnected form-function relationship of cities creating Jacobs’ ‘unrehearsed choreography’ on streets can often be found in many Japanese cities (Figure 3.5).
Ten years later, another important theory of understanding cities as interconnected systems was provided by two key works ‘The Social Logic of Space’ (Hillier and Hansen 1984) and *Space is the Machine* (Hillier 1996). As the key figure at University College London, Hillier also underpins the importance of the interconnections between physical means to functional ends of cities as non-hierarchical structure and that a city is more than the sum of its parts. He sees the failure of the modernist design and planning due to the separation between the form and function of cities as independent systems. While the former book reveals the interconnection between spatial configuration and social function as space syntax, it is really the later one that provides a more matured theory, which points out the philosophy of it as the ‘Movement Economy’ (Figure 3.6).
He explores the relationship between spatial configuration and functional distribution through movement, and the centrality of his theory is the concept of how the spatial configuration of an urban structure affects the functional world operation in cities. His theory extends Jacobs and Alexander’s ideas with some quantitative quantification and is further complemented by Bentley et al. (1986) and Marshall (2005).

![Image of London Space Syntax](image)

**Figure 3.6 – An Example of Space Syntax of London indicating a Movement Economy**  
(Hillier 2014, p.21-23)

Around the same time, in 1985, a practical book, ‘Responsive Environment’, was published under the influence of Jacobs, Alexander, Hillier, and some other sources. The central idea of the book is to show the ‘important relationships between social life and the arrangement of the built environment’ (P.144) through seven interconnected qualities of the forms and functions of cities: ‘Permeability, Legibility, Robustness, Variety, Richness, Visual Appearance and Personalization’, which work together to create a ‘responsive urban environment’ (Figure 3.7). Although it is more about a step-by-step guide to show designers and planners how a good urban environment can be created, its central underlying philosophy is to understand cities as an interconnected system, which is what the term responsive really means. The structure of the book itself
is also a good interpretation of the complexity of cities and the interrelationship between its parts.

Figure 3.7: Responsive Environment Diagram (Bentley et al. p. 9)

Just a year later, a similar idea, under the influence of Jacobs, Alexander and other theorists, Gehl’s book *Life between Buildings* (1987) is considered as a milestone of the study of public space (Vliet & Perks 1993), and his book *Cities for People* in 2010 continues those ideas and calls for the care of people in city design. Inheriting from Jacobs’ ideas, Gehl also emphasizes the connection between physical forms of cities and social behavior (see Figure 3.8). His central argument has three levels: firstly, movement and activities have a ‘self-reinforcing’ quality, which can be maintained and strengthened by a well-designed physical form and spatial arrangement at a micro scale; secondly, only when the designs of forms from macro to micro scale are all interconnected and work together, can the small scale design of space between buildings be truly well-functioning and well-used (Gehl 1987); and thirdly, city design should follow a bottom-up (or from part to whole) approach: starting from human activities to space and then to the built form (Gehl 2010). Gehl’s specific attention to human scale and detail design differentiates his study from the others. By focusing on the local level to understand the impact of the interconnection between physical form and its social use and performance, he argues for designing cities from the part to the whole. This also reflects Ashihara’s discussion of the nature of Japanese urban design and planning.
In the same year, Deleuze and Guattari proposed the ‘Philosophy of Assemblage and Rhizome’ in the book of ‘A Thousands of Plateaus’ in 1987. Their theory in its nature is another interpretation of Jacobs’ complexity, Alexander’s semi-lattice, Hillier’s Space Syntax and Bentley et. al’s Responsive Environment. They proclaim that a rhizome as a philosophical counterpart to the botanical term is an interconnected organic whole, that grows in all directions (see Figure 3.9). They define it as: ‘an open system’ (p.32) with multiple connections. It emphasizes the importance of multiplicity and interconnection between different parts constructing a non-organizational structure. As they wrote: ‘a rhizome connects any point to any other point…and is reducible to one or multiple…It is composed not of units but of dimensions, or rather dimensions in motion. It has neither beginning nor end, but a middle (milieu) from which it grows and which it overspills…(it) is made only of lines\(^5\): lines of segmentary and stratification as its dimensions, and the line of flight or re-territorialisation as the maximum dimension after which the multiplicity undergoes metamorphosis, changes in nature’ (p.42). They also indicate that a Rhizome is a multi-directional system that is not only opposed to the traditional Modernist notion of the tree structure and arborescent conception of knowledge but also opposed to dualism and binary choices. To some extent, this Rhizome concept resonates with Alexander’s semi-lattice structure as a form of thinking and structural organization of a system. The theory of Assemblage also inspires a more recent

\(^5\) As they also point out that these lines, or lineaments, should not be confused with lineages of the arborescent type, which are merely localizable linkages between points and positions.
study by Dovey 2016. He also remarks that cities are ‘Complex Adaptive Assemblage’, and argues that cities are made of both rhizome and tree as exemplified as smooth and strained space, which represents the bottom-up self-organization and the top-down institutionalized hierarchy.

Figure 3.9 – Diagrams of the Rhizome and Assemblage idea by the author (left) and a picture indicating a rhizome plant (right)

More than a decade later, while cities were still largely built on traditional modernist planning ideas, Arida (2002) provided a visionary overview of cities in his book Quantum Theory. His metaphorical analysis of the relationship between quantum physics and urban design offers a new perception of understanding cities. Arida claims that through the lens of quantum physics, everything in space can be seen as a duality (not dualism), where there is a particle and its radiating waves. In other words, he thinks that cities are open systems, in which they are ‘incapable of existing in a state of self-contained exclusion. They can find a dynamic equilibrium that allows them to regulate their energy into a creative order (p.141).’ He derived the basis of his theory from metaphysics and uses the ‘interference model’ to indicate how cities should be understood. The particle and its wave in itself is a system, which is also in constant motion. Cities are, therefore, made of a huge number of particles with their overlapping waves to create an impetus in energy and new things (Figure 3.10). He also indicates that traditional Chinese philosophy and urban design methods (Fengshui and Tao) bear some similarities to quantum theory (p.81-6). Therefore, his model is obviously again illustrating the importance of interconnection and overlapping; and more importantly, it offers a system of thinking that is dynamic and changing.
As a mathematician, Salingaros has the ability to translate some scientific concepts into architecture and urban design ideas. Having had working experience with Alexander, he shares the same critical perspective of the role of modernist planning in the destruction of the complexity of cities. Salingaros introduces the idea of the urban web (see Figure 3.11) and fractal characteristics of cities (see Figure 3.12) in his book: *Principles of Urban Structure* (2005). As he claims that it ‘provides us with a different way of thinking about an urban area, the urban web is not ‘the geometrical form that is of primary importance. Rather, the web consists of activity nodes and the physical connections (here: paths) between these nodes’, which ‘is often solely a carrier for collective activities...’ and ‘it can be anything that attracts people, like a house, a hot-dog stand, a shaded bench, or a public transport stop (p.15)’. This book complements and develops Alexander’s idea of a semi-lattice structure as the backbone to his concept of ‘Urban Web’ and also echoes Jacobs’ central argument about the need for the city to be seen as a network of complex and interacting systems with understandable orders and rules. This urban web structure shares many similarities with Alexander’s semi-lattice, Arida’s particle-wave model and also reverberates in Gehl’s theorization of space between buildings as a complex organizing structure (2005, p.17). Especially, he also quotes Jacobs’ idea of urban complexity: ‘By adding or replacing connections and nodes one can bring a dead urban area back to life. In doing so we are organizing the complexity of an urban area (Jacobs, 1961 cited by Salingaros 2005, p.15)’.
Under the influence of Jacobs, Alexander and Hillier, Stephen Marshall's *Streets and Patterns* (2005) and *Cities, Design and Evolution* (2009) complement each other as two sibling books, indicating the idea of urban complexity in relation to its form and function, which is built upon reflection and criticism of modernist planning. While the first book covers ten years of research exploring the interrelationship between transport (movement circulation) and street patterns (built form), it is really the second book that more clearly indicates the intricate and complex urban order and the importance of the interconnections between part and whole, processes and patterns, and forms and functions of cities (Marshall 2009, p.16 and Chapter 3). By proposing the idea of cities as an ecosystem, he conceives cities as collections of inter-dependent and co-evolving units, sub-units and super-units organized by urban syntax that ‘are partly in cooperation, but partly in competition’ (ibid. p.18). He believes that such an understanding of cities allows people to appreciate the qualities of cities as a
constantly evolving interconnected structure, rather than as fixed relationships between the parts and the wholes. To some extent, this is also similar to Hillier’s space syntax and Alexander’s semi-lattice structure with overlapping sets and sub-sets.

Comparing all those theories and ideas, they are following the same logic of understanding cities. Jacobs’ ‘Organized Complexity’ equals to Alexander’s ‘Semi-lattice’ way of thinking, and they resonate with Hillier’s Space Syntax, Bentley et al.’s responsive environment, Deleuze and Guattari’s Assemblage and Rhizome, Gehl’s ‘life between buildings’, Arida’s Interference Model, Salingaros’ Urban Web and Marshall’s evolving ecosystem. That is to say, although they interpret this idea with different metaphors and conceptual models, all of them note the importance of the interconnection and multiplicities between form and function of urban complexity and the need to understand a city as something more than the sum of its parts. Interestingly, those theoretical conceptual models share a very similar resemblance to Eastern Areal thinking, which emphasizes this lateral and multiplicities of thoughts and way of conceiving the world as discussed in the previous chapter.
3.2.2 Interrelationships between Street Network and Functional Activities:

Between the physical and functional spheres of cities, the most dominant and powerful interconnections can be understood from the interplay between streets and activities. Jacobs provides a good insight of the functional importance of cities and argues that a number of qualities for built form as structural keys generate synergies, vitality, convenience, and safety in cities. These characteristics of built form include short blocks and frequent streets, many corner sites and congregation points; active street frontages, and a mix of primary uses, building types, ages, sizes and even people at high concentrations and densities in an urban environment. These qualities can be categorized into building and space in a physical system and movement and activities representing a functional system (see Figure 3.13). Among these, the street network and functional use of space take a more determinant role in this interconnection.
On the physical side of the equation, there is an ‘internal urban order’ that ties different physical elements (predominantly building and space) together (Marshall 2009, p.36). At the same time, the forms of cities are hence mostly connected and shaped by their streets, which can also perhaps most clearly reflect the urban order (ibid, p.29). Jacobs indicates the importance of the street: ‘think of a city and what comes to mind? Its streets. If a city’s streets look interesting, the city looks interesting; if they look dull, the city looks dull (p.2)’. Her simple description of streets reveals a profound meaning behind it: streets as public space not only provide physical channels for movement of all modes as a structural skeleton, they are also places to accommodate Gehl’s ‘life between buildings’. Moreover, it also reveals its crucial relationship in terms of defining the block structure and built form, which in return defines the streets as the most central backbone of an urban structure as a form of connection (Salingaros 2005). They shape the sizes and appearances of buildings to create the physical form of cities and take the role of creating and sustaining various social, economic and cultural human activities and socialization (Jacobs 1961, Marshall 2005 & San Francisco Planning Department, 2010). The spatial organization of streets as Jacobs suggested is decisive in terms of determining the success of cities, and they further support the mix of various activities and movements. It is not a two-dimensional artifact, but a three-dimensional structure that is formed by both building and space, buildings give it shapes and spaces connect them as a whole.

On the socio-functional side, ‘street choreography’ is a very poetic label to depict the functional mechanism of cities by Jacobs. Movement and activity are the central agents that deliver the performance and message that a physical structure possesses, and they shape and are shaped by the purpose behind those physical structures: either cultural-political or socio-economical intention (Hillier 1999). This is explained by Alexander as a semi-lattice structure that can create an observable phenomenon: along a street, there is a bank, a grocery store, 

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6 Marshall states that the internal urban order of modern cities can be noted as: ‘the combination of stand-along buildings, separated from vehicular routes (hence the dissolution of the street as an urban form); the segregation of transport modes themselves (particularly between fast vehicles and slow pedestrians); multi-level circulation (including buildings over roads). (Marshall 2009, p.36)
a bus stop, a laundry and a café next to each other, people can go to the bank to get some cash to buy a newspaper and groceries and send clothes for washing while having a cup of coffee and waiting for the bus. The proximity and connection of multiple functional uses of space can provide more conveniences and enjoyable experiences for urban ‘dancers’ and improve business by attracting and sharing more customers and creating economic and new social interactions. This is what Jacobs’ street ballet really ‘dancing’, and it shows the scene of a complex and successful city through its street.

Metaphorically, the street network, movement and activities in the life and death of a city are as vital as the blood vessels, blood circulation and metabolism in a human body. Streets carry movements to generate activities, just like blood vessels carrying blood with nutrients and waste in and out from organs to maintain the metabolism and different functions of a body through circulation.

However, not all cities have good interplay between streets, movement and activity. Some cities tend to have less interplay, while some others have more (see Figure 3.14). This is because the way in which people design their cities reflects on how they understand them (Hillier 1996, p.149; Alexander 1965, Salingaros 2005), so that different street patterns are created to generate different urban forms that accommodate divergent social and functional impacts. While a tree structure mode of thinking can create a street network with a tree pattern that limits the interconnections of a city, a semi-lattice mode of thinking as Alexander argues can generate a Jacobs’ ‘street ballet’ phenomenon and this is also what Hillier’s Movement Economy has pointed out:

‘... Well-functioning cities can, therefore, it will be suggested, be thought of as ‘movement economies’. By this is meant that it is the reciprocal effects of space and movement on each other (...), and the multiplier effects on both that arise from patterns of land use and building densities, which are themselves influenced by the space-movement relation, that give cities their characteristic structure, and give rise to the sense that everything is working together to create the special kinds of well-being and excitement that we associate with cities at their best.’ (p.152-153)
As Hillier remarks, the ‘structure of the urban grid itself is the most powerful single determinant of urban movement’ (p.43). All the movements, themselves determined by the nature and visibility of the spatial configuration of a city, decide the level and distribution of vitality of socio-economic activities. This concept claims that the spatial configuration of the grid (primarily the street network) influences the pattern of movement and then affects the distribution of activities in cities, which further attracts a greater flow of people that stimulates the activities as attractors (functional uses of space). This sociological process in any urban structure is called a multiplier effect, which stimulates the dynamic interaction between the structure, movement, and its activities. In Salingaros’ words, the ‘interior logic of a city’s disorderly grid is fundamentally about movement, so that many properties of urban space are a product of these connections (p.36)’. This is an opposite theory to the conventional understanding of the movement function relationship because he claims that the configuration determines the functions, not the other way around.

Figure 3.14 – Space Syntax mapping of Beijing (left) and Tokyo (right). These maps indicate the level of connectivity of city networks in Tokyo and Beijing according to spatial analysis of the urban grid. It indicates that Tokyo performs much better than Beijing (Hillier 2014, p.21-23).

Similar to Hillier, Gehl is also concerned with the relationship between spatial structure (space between buildings) and human activities in space (social functions), but he approaches the importance of the street and its activities by exploring the quality of public space and its impact on activities at the human
scale. He argues that the intensity of outdoor activity increases concurrently with the quality of physical environment at differing scales and to various degrees (see Figure 3.15 left). The ‘physical structure reflects and supports the social structure’ by classifying the different types and levels of social behavior (walking, sitting, standing, seeing, hearing and talking) with their corresponding desirable physical form (of building facades, floor level, position, and orientation of seating etc.). In other words, there are many intricate interrelationships between buildings and space that can foster different types of social use and generate a different flow of people and cars (see Figure 3.15 right). For Gehl, a good urban structure indicates that the ‘space between buildings’ (mainly streets) at a human scale allows people to connect and interact with each other to generate the self-reinforcing process.

![Figure 3.15 - The relationship between the quality physical environment and types of human behavior – left (Gehl 1987, p.11), and the relationship between different physical forms and human behavior movement-left; activity/interaction-right (Gehl 1987, p.62, 81,101, 113).](image)

This kind of interplay as described is also a responsive built form that can give people a ‘degree of choice’ to use or move across space (see figure 60 & 61) as proclaimed by Bentley et al. (1987). They also argue that permeability is the most fundamental one among the seven qualities that are required to create a responsive environment. It is supported by a well-connected street network and provides the essential structure for cities to offer more choice of routes for people to use. The street network that defines block structure is obviously the most important physical form that can represent this quality. Bentley et al.’s
approach to understanding street connections between the inside and outside of a study area also indicates the importance of depths and links of a street network. The other six qualities indicate direct phenomena that are created by social activities and movement with the street structure as a base. In other words, the seven qualities of a responsive environment illustrate the important interrelationship between street network, movement and activity, and interconnection between form and function of cities. Figures 3.16 and 3.17 indicate the two street structures shown in their book, and these represent the street network in Chinese and Japanese Superblocks respectively. Their permeability also resembles Jacobs’ idea of having the short blocks and frequent streets as the basis of a good urban form to generate synergetic activities. For Bentley et al, a good urban structure should have these seven qualities to create a responsive environment that can generate movement and activity and allow interactions between the seven qualities. It is important to have a well-connected street network as a basis to sustain ‘a good pool of use’ and further maintain the good economic and social quality of an urban structure.

Figure 3.16 - Less connected structure with fewer choices (top) and better connected structure with more choices (ibid, p.10)

Figure 3.17 - A method of mapping the permeability of a Superblock (down). (ibid. 1985, p.16)
Arida visualizes this interplay as the duality of activities: the relationship between physical movement and social interactions. He proposes an 'interference model' with an 'event' and 'event horizon' to show the importance of mixed functions (see Figure 3.18). As Arida has explained, while an 'event' can be a thing or a happening, which is also the 'source of waves that spread over a territory', an 'event horizon' is its complementary area of the wave that provides the interconnection between different events. Interactive and overlapping impacts between different events can further give birth to a new 'event' with new patterns of the wave by overlapping and interfering with the original waves (see Figure 3.19). In other words, the event represents the physical form of a building or a street, while the horizon represents the functional impact from the event in forms of movement and activities. This process keeps repeating itself constantly and creates a 'chain reaction of events that transform a whole system' (ibid, p.212, see Figure 3.18 & 3.19).

He further applies this model to interpret how modernist planning and the design of zoned and community type cities separate cities into parts. He also suggests the concept of the quantum type city, which allows a vibrant and interconnected structure with overlapped and interacting functions (see Figure 3.20). Arida’s dualist thinking and interference model also supports and complements Alexander’s idea by providing a new mindset that allows designers to think in a ‘semi-lattice way’ and it also points out that every entity in cities
cannot be understood in isolation but through their interconnection and mixed functions.

Saltingaros decomposes the idea of the urban web into ‘human activity nodes and their interconnections’ (p.17) and argues the importance of multiple links between human activity nodes by making an analogy with the human brain as they both depend on multiple connections between nodes (see figure 3.21 & 3.22). The interplay between various human activities is synergised through movements that go through street networks, where multiple connections should be provided to maintain a well-functioning city as Hillier's Movement Economy describes. The interconnections and multiple links can be seen as the paths or street network patterns and as an organizing principle of cities, while the nodes are carriers for collective human activities and functionalities. They are self-organized into a ‘multiple connected but not chaotic’ web (p.19).

Marshall 2005 emphasizes the importance of traffic to an urban design by exploring the connectivity of street patterns and urban networks. He claims that ‘To a significant extent street pattern is - and must be - influenced by the geometry of movement and the typology of route connectivity (p. 13)’. Based on...
this idea, he offers a systematic and tangible classification of different types of street patterns and urban networks at the city and local scales as a methodological framework to explore the different possibilities of how the tree and grid networks can be combined with each other at different scales to assist or obstruct movement and activities. Marshall’s exploration of the street structure also provides an important reference and some methods to understand how existing cities are constructed and how new ones may be designed (see Figure 3.23, 3.24, 3.25). Although he mainly focuses on the investigation of the physical network, the idea behind it is to show the possible impacts on the functional side of traffic patterns that can be made by different types of street layouts.

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<td>Routes, Joints, Maximum Depth</td>
</tr>
<tr>
<td>Route Structure</td>
<td>Suggested Route Types</td>
</tr>
</tbody>
</table>

Figure 3.23 - Different mapping methods of street structures (ibid. p.96)

Figure 3.24 – Method of translating street structure into a map showing relationships between each street through depths (ibid. p.122).

Figure 3.25 - Method of translating street structures (a,b) to route or node-link maps (e,f). (ibid. p.119)

It can be clearly summarized from the discussion above that spatial form in cities can be conceived in terms of the buildings and ‘space in between’, which act as physical vessels to accommodate functional uses. At the same time, buildings also provide places for activities to take place as the origin and destination of movement as nodes, while space that is shaped by buildings create places for movement to circulate, and for flows to congregate, which can further generate activities in relation to the nodes. Therefore, spatial forms can change the distribution of movement between places, while activities that take place in space can also generate flows to change the physical form as a counter effect.
3.2.3 Integration, Connection, and Interaction as the Fundamental Principles of a Good Urban Structure

The interrelationship between city structure, movement and activities are mostly manifest in the interplay between the street network and the functional uses of space. Integration, connection, and interaction are three fundamental principles that need to be achieved to maintain a good interconnection between form and function systems (see Figure 3.26). The relations are not casual but reciprocal, and they overlap each other to create synergies that a good urban structure possesses. In other words, these principles are ‘laws of form and organization’ that ‘permit an infinite variety of different structure that establish a human connection,’ and ‘these ideas resonate with ordinary people’s assessment of what’s good and bad in the built environment’ (Salingaros 2005, p.12).

First and foremost is the importance of integration. In short, integration can be considered as the part-and-whole relationship, which is common to both top-down’ and ‘bottom-up’ processes in city design and planning. It is the integration of the operation of part-and-whole, and ‘top-down-bottom-up’ processes that make a good structure. Scale is a very important concept in understanding cities,
and integration is the idea of how spatial configuration across all scales (as a series of parts and wholes) works together to make a successful city.

Hillier (2001) proposes a ‘global-local’ theoretical model to understand the integration through space syntax (see Figure 3.27). This model indicates a dual production of space: 1) a local or residential process that is prompted by sociocultural forces generates differences in a local space with distinctive patterns and geometric shapes reflecting dissimilar but specific spatial cultures; 2) a global process of forming a public space is driven by the microeconomic activity as ‘a single overriding structure’ creating a ‘globalizing pattern of space which tends to be everywhere similar because the microeconomic activity is spatially universal’. These two processes create respectively an ‘underlying pattern of differences and invariants that we find everywhere in settlement forms’. (Hillier 2001, p.10) He also argues that ‘local physical changes in a spatial system always have more or less global configurational effects. It is the laws governing this passage from local physical moves to global spatial effects that are the spatial laws that underlie building.’ (Hillier 1996, p.7) He further emphasizes the power of a city’s spatial form and structure and their deterministic impacts on the distributions of movements and activities across multiple scales. In other words, it is the global network of the structure of a city that determines where most of the movement will go, rather than any particular destinations (Hillier 1996).

Figure 3.27 – Global Integration of Baltimore and Venice. The darker colored lines indicate more integrated parts as a global network, while the lighter lines represent the local (Hillier 2001, p.8).
Moreover, Hillier asserts that the key factor in making a successful city structure is the ability to move easily through multiple scales from global to local systems, which are all connected structurally and affect each other. The more integrated a network is locally, globally and across scales, the more functional attractors it will create. Any small changes in the spatial structure can lead to larger changes of movement and further alter the performance of socio-economic activities of a place. In other words: 'Places don't make cities, cities make places' (ibid. p.149).

Integration thus has a domino effect that provides interconnection at different scales across a whole system. A vibrant, convenient and safe city environment can only be assured with good integration within city systems. To Hillier, Integration is a different property to permeability, connectivity, and accessibility in that it calculates an integration value for each link in the network according to its topological measures of access to all other links in that network. Space Syntax was correspondingly invented as a method/tool to measure this interrelationship through network integration of an urban structure. This will be used as one of the methods that are discussed in the next chapter.

Similar to Hillier, Salingaros also stresses the importance of the integration between different scales by claiming that the urban web can create an 'ordered hierarchy of connections on several different levels of scales' to maintain the self-organization of the system', which follows a strict order: starting from the smallest scales (footpaths), and progressing up to the higher scales (roads of increasing capacity)' (2005, p.19). This indicates that any missing or disrupted connections at any scale can make the whole system become dysfunctional and 'pathological', because 'in any complex system, organization proceeds from the small to the large (ibid. p.35)'.

For Jacobs, the idea of integration can be understood as the way in which parts of a city can be more effectively working with the whole and how different levels and types of functions can cooperate across different scales. She suggests the creation of a 'lively and interesting' street fabric as 'continuous a network as possible throughout a district of a potential sub-city size and power' knitting with parks, squares and public buildings to increase complexity and intensity. It
is therefore possible to have a functional identity serving as a self-containing and interacting district (p.139). Her discussion not only covers functional mixes from an intermingling of local street stores to specialized districts and city areas as an economic force at different levels, but also how each community or neighborhood can be better incorporated to make a city as a whole. This is in juxtaposition to a number of isolated islands as proposed by the Modernists in their Superblock projects. This emphasizes that the functional mix can only be achieved with good integration across scales with proper structural supports. Here, her suggestion is clearly indicating the importance of integration through the part and whole relationship by emphasizing the street network's spatial configuration and functional incorporation across scales.

The importance of integration is also discussed by Gehl and Marshall, who see integration as interconnection across scales from different perspectives. Gehl (1987) argues that integration is the capacity, which comes only when the designs of the forms from macro to micro scales are all interconnected and work together. Only in this way, can the small scale design of space between buildings be truly well-functioning and well-used. Marshall (2005, p.15) focuses on the study of the street network and sees its wider impact on the whole city through interconnections at multiple scales. He also challenges people to think that streets are 'not just as an isolated architectural set piece, but as a contribution to wider urban structure'.

Integration can also be understood as the overlapping of different functions as in Alexander's semi-lattice structure, as in Arida's overlapping of waves of particles, and as the co-functioning of the seven qualities in Bentley's Responsive Environment. For Arida, a desirable urban structure should have connected and overlapped functions that can generate new activities to maintain the interactive dynamism of a city's complexity. Integration also represents a multiplicity of alliances, connections, and synergies between different places as the structure of a Rhizome or the assemblage of a number of interconnected sub-systems.
The second principle is Connection. It primarily denotes the physical connectivity, permeability and accessibility of places and how people circulate around in cities to form movement patterns. It also implies the way in which information and social functions connect to each other in close proximity as a structure. 'Good cities are structured to maximize random social encounters and this is a significant part of how they work as urban economies and ecologies' (Dovey 2016, p.17). Jacobs' discussion of short blocks, more frequent streets and a mix of uses is an indication of the importance of creating a structure that is well connected both physically and functionally. The dense street network can efficiently generate more economic activities and social interactions 'only because of the way they perform' (Jacobs 1961, p.199). In other words, good structural connection creates a sense of 'Togetherness' as an old planning ideal that can be achieved from streets and their sidewalks (ibid, p.73). It provides an interconnected network for good permeability and accessibility for movement through the 'intensiveness of interconnectivity' and the 'capacity to move through the network using multiple pathways' (Dovey 2016, p.18). Similarly, Bentley et al. (1986) also argues that permeability as an expression of structural connection is the most essential quality in order to create a responsive environment and a connected network, which is fundamental to the generation of complex interconnections, giving people a degree of choice to move across space.

Hillier further indicates the importance of connection through his theory of 'configuration-movement-attractors': a well-connected space provides a good spatial configuration that can generate more movements and activities. The idea of connection is reflected in the structure of an urban grid or spatial pattern that can be simplified as a network of intersected lines and their depths. The connection in Hillier's 'global-local' model also means the process of creating a functional centrality in an urban structure. It often relates to a radial structure, a 'Spiky Potato shape' and 'a deformed wheel' because of the 'overall configuration of the grid' (see Figure 3.28), which decides where the center should be, and of the kind of local process of grid adaptation and intensification predicted by the movement economy' (Hillier 1999, p.14). Again, the inter-dependence and inter-
accessibility of the center that is determined by the structural connection also create phenomena of 'attractor inequality' and 'configurationally inequalities' (Hillier 1999).

It is crucial because the city structure as a whole determines this center, changing continually and undergoing a 'Siksna process'\(^7\) to intensify the center to a much smaller and more compact grid network as a more connected structure. Hillier (1999) also indicates that the grid structure tends to create a center with high movement levels, while the tree network redistributes the flow to the edge of the structure showing low levels of movement; the smaller the blocks and grid in the middle of a structure, the more movements and activities will be happening in the central area due to a more connected network. In other words, they indicate that the level of connection of a street pattern has a deterministic role of generating movement and activity in cities and this is the key to creating a good urban structure. In the later investigation of four Superblocks cases, this centrality phenomenon exists in both the whole city grid and also within the network of each Superblock. This implies that the Chinese and Japanese cities have a non-radial structure without a 'deformed wheel' configuration.

Figure 3.28 – Centrality and Spiky potato shape of city structures (Hillier 1999, p.13)

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\(^7\) 'Siksna process' refers to the process of the grid intensification and smaller block sizes in city centres that can increase the system efficiency for movements (Siksna 1997). In Hillier's (1999, p.2) words, 'spatially, the movement economy process works at two levels in generating a pattern of centrality: a global level and a local level. Globally, the process selects locations which have the appropriate degree of integration with respect to the settlement as a whole. Locally, locations are selected with certain local grid conditions. Both aspects of the process are dynamic. As settlements grow, the pattern of global integration is likely to change, and this will create spatial pressure for a shift in the focus of centrality. An outward shift is the most characteristic manifestation of this. Locally, as centres grow, they create pressure for greater local integration of the kind described by Siksna, that is grid intensification and smaller block size to allow greater ease of movement within the centre. The greater the scale is of the centre, the stronger the 'Siksna process' will be.'
Marshall’s study also indicates the importance of connection. He concludes that a grid network as the most connected network can provide multiple connections and more structural permeability. He offers a systematic and tangible classification of different types of street patterns and urban networks at the city and local scales as a methodological framework to explore the different possibilities of how the tree and grid networks can be combined with each other at different scales to cater for or obstruct movement. His diagrams also suggest that the grid network is the most connected structure to make internally well-connected cities (see Figure 3.29). For Marshall, the level of connectivity and integration of a street pattern has a deterministic role for generating movement and activity in cities and this is the key to the creation of a good urban structure.

<table>
<thead>
<tr>
<th>Macro:</th>
<th>Linear Type</th>
<th>Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree</td>
<td></td>
<td>Least connected</td>
</tr>
<tr>
<td>Grid</td>
<td></td>
<td>Most connected</td>
</tr>
</tbody>
</table>

Figure 3.29 - Mapping of different street structures (Marshall 2005, p.96)

This is also argued by Salingaros. He states the importance of having multiple interconnected links in an urban web, which can maintain movement and generate diverse activities. It, in essence, emphasizes the importance of the connection between form and function at different scales, which is the key to sustaining a self-organization of ordered, interconnected and diverse urban environment. More importantly, it reflects the ability to connect across scales to create integration as indicated by Hillier. In other words, similar to Arida’s particle and wave model, it is the overlapping functions that are connected through multiple links that create the synergy and convenience that cities need. It also reflects the idea of an assemblage, which is defined not by ‘its parts but by their connections and flows, by the ways it produces desire’ (Dovey 2016, p.167).
On the other hand, Alexander's overlapping functions and Arida's overlapping waves both represent the importance of having multiple connections in street networks. Multiple links, either in a semi-lattice structure or particle-and-wave model, provide structural connections that maintain functional mixing that are located in proximity to create synergetic phenomena, which are 'highly complex' (Salingaros 2005, p.21). The connection is important because of its special quality of being able to initially have multiple links between different parts of a system physically, which then naturally affects the actual functional distribution. Similarly, Hillier (2001) also claims that configuration generates attractions, not the other way around, and 'it is the organized complexity of a functioning urban web that determines its overall form, and not the other way around (Salingaros 2005, p.21)'.

For Jacobs and Gehl, connection also means an urban web that is interweaved by the porosity of the street interface and diverse activities across multiple building levels at the smallest scale. The ‘eyes on streets’ indicates a multi-level connection at a human scale that presents a differing degree of contacts that can increase or decrease the level of safety through the structural organization (Jacobs 1961). All elements, including sidewalks, streetlights, seats, staircases and multipurpose street furniture, give ‘more interesting city elements and permit a greater diversity in the use of the city space’ (Gehl 2011, p.169). All these physical structures contribute to the urban web by increasing the connections between different parts to knit a semi-lattice web-like Rhizome structure that the life of a city presents. In other words, connection means the organizational principle that makes cities work more effectively. The stronger the connection, the more multiple connections within these sub-systems, the more movements and activities cities can have.

**Interaction** is, as Dovey (2016, p.29) points out: 'the issue of mix in urban design needs to be understood not only as a functional, formal and socio-economic mix but in terms of the interconnections and synergies between them – the mix of mixes'. It does not only require a high mix of social interactions, but also a combination of various types of physical structure to support the
functional mix. In Jacobs’ terms, they together can create the fusion of different streets, blocks and building types, sizes, ages, patterns and an intermingling of different social classes with various levels of income and rents. These ‘mix of mixes’ together create a mix of grain sizes, densities, intensities, and synergies through multiple connections that can facilitate ‘multiple information exchanges’ to complete the urban complexity as remarked by Salingaros (2005, p. 174).

Jacobs’ concept of the ‘self-destruction of diversity’ (1961, p.255) reveals the importance of the diversity of mixed functions to keep the vitality and long-term operation of socio-economic activities alive, because single functions with few interactions will become ultimately destructive. Interaction also indicates overlapping different functions (Alexander 1965) through a semi-lattice structure to create Jacobs’ ‘unrehearsed choreography’ on streets. It is not simply described as the proximity of different functions, but also as the mix of those functions at different levels of a city structure to generate synergies through facilitating movement and activities. Bentley’s variety, robustness, richness, visual appearance and personalization in a responsive environment also resonate with Jacobs’s idea of interaction, and they demonstrate how the physical structure can support such functional interactions through design.

In addition to the idea of intermixing, Arida’s model also illustrates the importance of dynamic and constant change, which is a key to the production of multiplicity and flexibility in a complex system. The need to be able to change is also at the core of a desirable urban structure, which should have a connected structure to support the overlapping of different functions and generate new activities to maintain the interactive dynamism of ‘urban complexity’.

Interaction for Hillier can be interpreted as the ‘Multiplier effects’ between structure-movement-activity relations. Activities are, in Hillier’s term, the functional attractors that feed on the movement of people. Normally, they are the primary visitation functions (or primary functions by Jacobs) such as shops, restaurants, offices and public functions. These movements can also be generated by a more integrated and connected network, which further generates
the kind of functions that feed on flows and support the secondary functions, which in turn attract more flows. In this process, a denser network can create functional density, which again enables greater flows and concentrations of attraction. These are multiplier effects between the network, movement, and activities that are created by the interaction between formal and functional relationships. Any changes to the network can change the flows within it and affect functional and social mix.

This multiplier effect also echoes the idea of ‘Multiplicities’ discussed by Deleuze and Guattari. They are ‘rhizomatic and expose arborescent pseudo multiplicities for what they are’. ‘... they are flat, in the sense that they fill or occupy all of their dimensions (1987, p.8-9)’, presenting a plane of an assemblage of liaisons and relations between them to foster co-functioning, which also reflects Jacobs’ mix of different functions and people to create multiple synergies. Interaction presents itself as a form of multiplicity, which is made by intermixing different functional uses. In turn, this is generated by a non-hierarchical rhizome-like city structure.

Furthermore, the interaction can also be found across levels, because ‘any understanding of mix entails an understanding of how mix changes at different scales’ (Dovey 2016, p.26). At this human scale, interaction can be understood as Jacobs’ mix and ‘eyes on streets’, which imply a vertical mix with retail on the ground floor and housing or office space above. It also can be seen as a horizontal mix at the street level with shops and factories locating in proximity and forming high porosity (Gehl 1987 & 2010). At the neighborhood or district scale, there may be a mix of retail, factory, and recreation that makes a self-contained district; and these neighborhoods can be seen as specialized districts at the city scale. Thus, interaction becomes extremely hard to map, but it reflects the nature of the complexity of such intermixing. In other words, understanding the interaction is not simply to see where functions or land uses occur, but also to understand where they mix and co-function. Simply, Jacobs’ observation illustrates this interaction as street choreography, and street intersections are the focal point for such mixing.
3.2.4 Implication and Reference to Methods: Key Measures of Form and Function

As discussed above, street network, movement, and activities are the key determinants in the conversation between physical form and social function. They are interrelated to each other through integration, connection, and interaction to generate urban synergies. In order to understand the street network and functional activities/uses of the Supergrid and Superblock structure, six variables are discussed here. They are not only ‘multiplicity of interconnected concepts’ (Dovey 2016, p.31) and ‘internal urban orders’ (Marshall 2009) to create urban organizational rules, but also crucial measures, which are inspired by the Interconnection theory and widely used by a number of empirical studies. How they are used as measures is further developed as methods in the next chapter. This section only introduces those concepts as a theoretical basis.

3.2.4.1 Empirical Studies: Qualitative and Quantitative Measures

There are many empirical studies that focus on the investigation of the interrelationship between urban structure, movement, and activity. They can be found in two major groups: 1) the group concerned with social and environmental issues with little theoretical basis; and 2) the group founded on Hillier’s space syntax theory.

This first group of empirical studies can be considered as a direct response and testimony to the Interconnection theory and its intellectual descendants: the post-urbanism and new urbanism. They grew out of concern and observation of the increasing socio-economic and environmental costs resulting from the overuse of automobiles (Crane & Crepeau 1998 and Katz 1994). They were carried out to determine how the built environment continues to affect different types of human movement and activities. These studies do not possess a clear theoretical foundation as a basis (although some of them do have strong influence by Jacobs), but they are mostly aimed to justify the validity of the
claims and theories of the New Urbanism. One of the most influential movements is the reconsideration of the traditional compact, mixed-used and pedestrian-oriented neighborhood in America in the nineties (Cervero and Radisch 1996). Their method is to convert different kinds of qualitative and quantitative physical and social variables as measures for mathematical calculation in order to see numerical correlations between structure, movement, and activity. This group strikes in two directions: firstly, the relationship between built environment and travel in terms of the operation of transportation systems and secondly the relationship between built environment and physical activity that is concerned with human health.

The key message from the first group of studies is that trip frequencies, trip lengths, and mode choices all affect, to varying degrees, movements and urban functions. By controlling the socio-economic characteristics (population, income, age, gender), these studies usually explore the general connectivity of street structure, land use patterns and accessibility in order to find out how built form affects different types of human movement and activities through mathematical correlations.

The second direction explores the relationship between built environment and physical activity in relation to public health and the walkability of a physical environment. Although some of these studies are health related, they are, in essence, indicative of how certain built environments affect the choice of travel mode. These studies usually consider more detailed elements of the design of the physical built form at micro-scale, including the existence of sidewalks, street lights, traffic lights, crossings, disabled access and the distribution of vegetation, green space, barriers and even the natural landform. These studies show similar interests to those of Gehl.

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This group of literature is so vast that many of them are simply reviews of existing studies. They built on each other’s findings and conclusions to explore the interrelationship. At least fourteen surveys have systematically reviewed many other studies. The most recent review was by Ewing & Cervero (2010), who summarized a ‘5D model’ (Density, Diversity, Design, Destination Accessibility, and Distance to transit) to measure the built environment. They also conclude that the strongest influences on walking are: Intersection Density, Diversity of uses and Destinations within walking distance. Of importance but comparatively weak are: Population density and Job Density (see Table 3.1).

<table>
<thead>
<tr>
<th>Category</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Land Use; Block, Street, Intersection, Cul-de-sac, Parking, Residential, Employment</td>
</tr>
<tr>
<td>Diversity</td>
<td>Land use, Building age, dimension and types, street networks</td>
</tr>
<tr>
<td>Design</td>
<td>Neighbourhood Types, Sidewalks, Street lights, Trees, Curb, Bike path, Crossings, Parking</td>
</tr>
<tr>
<td>Destination</td>
<td>Bus station, Transit station, Shopping center, Job, Open space, Parking Service,</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Open space, Parking Service,</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Street network, Open Space</td>
</tr>
</tbody>
</table>

Table 3.1 – The variables that are studied by a number of empirical studies

The second group of studies is founded on Hillier’s theory. Space syntax is created as a tool to understand the interplay through the integration of the spatial configuration of city structures through the combination of mapping and numerical calculation. Despite some issues and questions that have been raised (Ratti 2004 & 2005), this is by far the most promising empirical method of analysis that also has been used for real practice with some encouraging results. Moreover, permeability of Bentley et al and Marshall’s route structure are also inspired and derived from Hillier’s methodology. Therefore, space syntax clearly offers a much more systematic empirical method for the analysis of urban structure, and it will be further discussed in the following chapter.

However, Crane 1996 and Guo & Chen 2007 point out that these empirical studies present very mixed findings of the way in which the built environment affects human movement and activity because of the difficulty of controlling socio-economic characteristics, self-selection and publication bias. This is largely
because the results of those studies are very sensitive to statistics, which are created upon mathematical equations. However, it is not sufficient to understand the complexity of cities as ‘two-variable problems’ through traditional scientific approaches as discussed by Jacobs, and therefore a more appropriate method of exploring the interrelationship is needed. Although Space Syntax has a similar problem as a numerical study, it is much more plausible because it links statistic models with spatial mapping of urban structure.

In general, these empirical studies have three levels of implication for this thesis. Firstly, most of the findings support the ideas of the Interconnection Theory by indicating a strong relationship between the built environment and human movement and activity: more compact and connected street networks and mixed land use are strongly associated with more walking and less use of the automobile. Secondly, among many different variables, street pattern and land use distribution were most commonly investigated as discussed above in the Interconnection theory. These prove to be two key determinants that are further studied in this research. Thirdly, they reveal a number of measures that can be used for spatial analysis.

3.2.4.2 Understanding Key Concepts as Measures for Methods

Among all different measures, density and intensity, type and variety, and pattern and distribution are more often measured to investigate the street network or functional distribution. The six measures are also widely discussed by many studies from Interconnection Theory as spatial organizational rules (Figure 3.30).
**3.2.4.1.1 Density and Intensity**

Density is a measure that can be understood as ‘the degree to which people, buildings, and activities are concentrated (Dovey 2016, p.31), and ‘high densities are often seen as a prerequisite for economic growth and sustainable urban development’ (Nordic Journal of Architectural Research 2014, p.12). It can be used to measure both building and space of an urban form since it is affected by the intricate relationship between dimensions, sizes, and numbers of objects. It is discussed in detail by Jacobs throughout her book. Her strong emphasis on the concentration and proximity of streets, blocks, and buildings shows a clear emphasis on the importance of density, which is crucial to the vitality of cities. Gehl indicates this importance of density through the discussion of how it affects building heights and sizes, which ultimately influences the enjoyment of the physical structure of human activities (1987). Salingaros also remarks that: ‘without a sufficient density and variety of nodes, functional paths (as opposed to unused ones that are purely decorative) can never form (2005, p.27)’. The urban web as he proposed is a hierarchical organization that needs proper density to structure the whole. The parts and the interaction between parts are simple, but
the accumulation of the parts will make a highly complex whole (Alexander 1965, Salingaros 2005, p.36). In other words, density transforms cities into a number of interrelated complex dynamisms, and this is how the relations between buildings and spaces are orchestrated.

While Jacobs (1961, p.254) and Dovey (2016) argue that higher density can generally create a higher functional mix and walkability, Salingaros points out that density is not always a good thing. A high density of streets and blocks can also be destructive to city structure as they can create non-functional ‘decorative paths’ for connection and sacrifice other social functions, such as ‘(the) offer (of) safety from crime’ (2005, p.34). This also indicates that the magnitude of density needs to be properly understood in order to reach an appropriate relationship that can facilitate rather than impede the relations to movement and activity.

Intensity is a quantitative measure that cannot be triggered by simply increasing the level of density of building and people, but through the ‘concentration of encounters and connections’ and ‘interconnections of density with mix and access (Dovey 2016, p.37)’. In other words, the intensity of movement and activity can generate the ‘street ballet’ phenomenon that is created by the concentration and mixes of activities and flows in between. Hillier’s space syntax measures the integration of spatial configuration that shows different levels of intensity of circulation and activity in different colors as maps. Arida’s interference model describes the importance of intensity as the overlapping of different waves/event horizons that radiate from different particles/events. In short, the more functions are overlapped, the higher the intensity gets, the more synergies and new functions can be generated.

Interestingly, there is a mysterious relationship between density and intensity ‘all kinds of urban intensity depend on certain levels of density, but through certain urban design control or rules, intensity can be produced without density and vice versa (Dovey 2016, p.37)’. To some extent, this reflects the multiplicity of the two measures as interlinked concepts that embody complexity and interconnection.
3.2.4.2.2 Type and Variety

Type is an object according to which one can conceive works that do not resemble one another at all (Quincy from Rossi 1982, p.40-41).’ It is ‘developed according to both needs and aspirations to beauty’ and each is ‘associated with a form and a way of life’ (Rossi 1982, p.40-41). As a cultural element that exists in all architectural artifacts, a type can be considered as ‘a bundle of interconnected parts that has congealed in a manner that enables repetition; it cannot be reduced to its parts because it is the whole that enables us to recognize the type’, and further it can help understanding the ‘language of urban morphology’ (Dovey 2016, p.69).

Jacobs emphasizes the importance of the mix of different types of buildings and streets. Legibility of a responsive environment as indicated by Bentley et al. includes Lynch’s five elements: nodes, paths, edges, landmarks and districts, which indicate a reduction of the physical forms of cities into five types. Marshall’s study of different types of the street layout with dissimilar topological spatial arrangements indicates a range of connectivity that each type can provide. Moreover, street types are not only affected by two-dimensional layout but are also formed by the buildings on both sides creating different types of interfaces at the human scale as discussed by Gehl.

Buildings are also vertical cul-de-sacs and enclaves (Yeang 2002, pp. 76-79 & Dovey 2016, p.181): these, by the nature of their structural requirements, usually possess tree structures, and different building types also indicate different vertical connections as continuations of roads and streets. While type can be understood as a ‘formal type’ or ‘functional type’ of a building (Dovey 2016), Rossi (1982, p.46-7) elucidates the importance to understand building type as a physical element of cities. While buildings can be classified as individual entities into six categories: ‘pavilion, row, courtyard, tower, slab and perimeter block’

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11 Firstly raised by Tompson (1917) as a process of biological deformation, type is a concept that can be used to describe many things in any field.
12 The former usually refers to the physical configuration of buildings and the latter is more widely accepted to understand the function of a building as a house.
(Lerup 1976), they can also be classified as ‘Compositional, Megastructure, and Group’ as three types of collective forms (Maki 2008). They both are useful for understanding physical built form of a city structure as cities are made of both.

While type provides a classification of different physical elements that deconstructs cities, variety (or diversity), on the other hand, is a rule for the mixing of different functions, types, ages, densities and people as a ‘mingling of high-yield, middling-yield, low-yield and no-yield enterprises’ (Jacobs 1961, p.201). An assemblage in itself is also made of a variety of different elements to form a non-hierarchical structure (Dovey 2016). When ‘easy accessible places are irrelevant unless they offer a choice of experience’, (Bentley et al. 1986, p.10) variety, as the second major quality of a responsive environment, can provide diverse experiences by mixing uses. These can be further enriched by a fusion of the sense of motion, smell, hearing, touch, and sight or by attaching personalized space (ibid.). Arida (2002) also discusses the importance of variety as the number of choices that a city can provide through the overlapping of different events representing a number of social functions. In another words, variety is equivalent to different functional sets in a semi-lattice structure and measures the accumulation of different choices of experiences and functions.

Jacobs (1961) further remarks that misunderstanding the nature of variety can be detrimental to cities through a process of ‘self-destruction’. She also indicates that variety should be understood as the number of dissimilar functions rather than of similar options in the same classification. For example, the mix of different types of shops that sell food or clothes do not necessarily equal to variety, but are in fact specializations. The true variety means the juxtapositions of restaurants, clothes shops, factories, offices, schools, houses and more. The consequence of misunderstanding the two concepts can lead to destruction of the synergy of a place by reducing needs and desires to move around that further create a reduction of the number of activities. This can eventually form a vicious loop that destroys a place.
3.2.4.2.3 Pattern\textsuperscript{13} and Distribution

'By encapsulating the essence of why similar structures arise repeatedly around the world and throughout history, 'patterns' represent the most intelligent decomposition of architectural and urban systems that has ever been attempted (Salingaros 2005, p.100). In fact, 'we observe the world around us and learn its structure by abstracting cause and effect, and by documenting recurring solutions obtained under different conditions, such empirical rules, presenting regularities of behavior, are called 'patterns' (ibid, p.191)'. These are 'encapsulation(s) of forces' and represent 'a way of understanding, and possibly controlling, a complex system' as 'necessary design tools' (ibid, p.198).

Cities are de facto made of combinations of different patterns that are fusions of open and closed systems with de jure public and private spaces and mixes of smooth (rhizomic) or striated (tree) spaces\textsuperscript{14} as discussed by Deleuze and Guattari (1987, Chapter 14). The urban web as proposed by Salingaros is made of such multiple interconnected open and closed systems across scales and represents numerous urban patterns. Marshall's (2005) explorations of different compositions of street networks: from the simple tree and grid to a combination of tree and grid, indicates a way to decode the street patterns in an urban web (see Figure 3.29). A tributary structure has a code of creating tree pattern street network, while semi-lattice or rhizome structure produces multiple connected street networks with the spatial code of a grid\textsuperscript{15}. Each composition represents an urban pattern, which provides different conditions of accessibility, permeability, connectivity, and depth.

\textsuperscript{13}The idea of the pattern as a language was proposed by Alexander et al. (1977) as a number of fixed modules to organize city. Alexander’s work has been widely criticized by many Architects, who claim that this work could hinder the artistic freedom of Architects. Salingaros, on the contrary, rather supports his work and thinks that ‘He looked for patterns of human activity and interaction, and analyzed to what extent the built geometry either encourage or discourage them (Salingaros2005, p.100)’, and ‘it is very short-sighted’ to deny the value of this work by overlooking the true nature of patterns as a language (2005, p.194). He also thinks that understanding patterns as a language is not going to restrict the creativity, but rather to help architects to avoid creating buildings that can be predicted to fail (ibid.p.198).

\textsuperscript{14}In short, a space in which war machine develops is a smooth space. It is organic and has less control. A space instituted by state apparatus is a striated space, which has a clear territorial rule and order (Deleuze and Guattari 1987, Chapter 14).

\textsuperscript{15}Le Corbusier’s urban proposal in Athens Charter of 1933 represents one type of pattern that is the reversal of traditional city structure, which represents another type of pattern.
While urban patterns can be mapped as an abstraction of a layer of urban complexity, distribution reveals how the movement and activities are located in an area. Distribution can be used to describe many things, but the distribution of land use is most commonly studied in urban research. Social activities and movements dwell in tangible structures (buildings and street) as physical patterns, which also represent a functional distribution. Hillier’s space syntax depicts the distribution of an urban economy through the analysis of the integration of urban grids. Arida’s particles and events with radiating wave model indicate how the distribution of each element in cities can affect each other to create greater diversity. Salingaros 2005 also elucidates that multiple connections between nodes (or Arida’s particle) are crucial to the structure that can affect how people move and use the space to form different functional distribution. In short, all of these works point towards the importance of location in a system.

Just as Hillier (1996, p.175) states that ‘the urban movement economy, arising from the multiplier effect of space, depends on certain conditions: a certain size, a certain density, a certain distribution of land uses, a specific type of grid that maintains the interface between local and global, and so on’. It is important to see that the six measures as discussed above are also by their nature representative of a number of spatial organizational rules. They work and reinforce each other to create different levels of integration, connection, and interaction by controlling the physical and functional systems that can further facilitate or impede the generation of movement and activities in cities. Rather than following any linear or hierarchical rules, they are all overlapped with each other and work as a rhizome structure. The six measures are hence further developed as part of the investigation method as explained in the next chapter.
3.3 Summary

This chapter sets out the theoretical basis for understanding a good urban structure of modern cities from a socio-economic perspective, and it can be epitomized as the Interconnection Theory. The central theory contains three levels of depths: 1) cities are organized complexities constituted by many interconnected formal and functional sub-systems through multiple links; 2) Capturing the structure-movement-activities interplay is an effective way of indicating the interconnection between form and function in cities; 3) Integration, Connection, and Interaction are three fundamental principles that a well-functioning city structure needs to embrace to generate and maintain good urban synergies.

Starting with Jacobs’s writings on the complexity and interconnection of cities, Alexander supported her idea by visualizing a semi-lattice organizational structure with overlapping functions. Together, they prepared the way for other theorists and their studies about the interrelationship between form and function of city structure. On one side, Hillier extends his ideas by introducing the concept of spatial configuration and space syntax as a method of measuring the connection and integration of different parts of a city through its network of spaces (largely streets). This has influenced and been complemented by Bentley et al and Marshall. While the former simplifies Hillier’s method of assessing the permeability of street structure, the latter develops Hillier’s method and creates a route structure to complement its disadvantages. Deleuze and Guattari 1987, on the other hand, provide a much more abstract and philosophical understanding of the multiplicities as an assemblage and rhizome structure echoing the essence of Jacobs’ complexity and Marshall’s evolving eco-system.

Jacobs’ and Alexander’s ideas were also adopted by Arida and Salingaros. Arida applies the metaphor of quantum physics to complement Alexander’s idea by accenting on the importance of interactions and overlapping of different functions. Salingaros applies the analogy of the human brain to supplement Alexander’s idea, emphasizing the importance of multiple connections between
human activities that can sustain the self-organization of ordered and complex city networks. The two interpretations of the importance of connection and interaction in cities both echo and clarify Jacobs’ early claim that cities are ‘organized complexity’ and ‘replete with unexamined but obviously intricate interconnected and surely understandable, relationships’ (Jacobs 1961, p.452).

Not only is there a strong connection between different theorists, each theory from the group has a different emphasis on what kind of principles and built form can contribute more to the stimulation of movement and activity. While Jacobs emphasizes the short block and a mixed environment, Alexander focuses on a semi-lattice movement structure with overlapped functions; Hillier claims the importance of connection of spatial configuration at multiple scales; Salingaros accents on the multiple links between different nodes; Arida places stress on multiple interactions between elements through a dualistic lens; while Marshall focuses on most desirable types of street pattern. Gelh is different again exploring form and function integration at a micro scale.

In addition, a group of empirical studies supplements and supports the Interconnection Theories by further exploring the impacts of structure and form on travel and activity behavior. The two directions of the empirical studies provide a number of variables and measures. While street network and functional use are most frequently discussed in the empirical studies, six measures are encapsulated from the discussion of those studies and further developed as design method as indicated in the next chapter. They overlap with the theoretical studies and further reinforce the credibility of the body of theoretical work concerned with integration, connection, and interaction.

From the standpoint of this thesis, both the movement theories and empirical studies also define a number of attributes of physical built form that can be used to measure the performance of urban structure in its facilitation and generation of movement and activities. These theories and studies will be combined and translated into morphological mapping techniques for this study and discussed again in the methodology part of this thesis.

End of Chapter Three
Chapter Four:
Methodology
4.1. Introduction

*Cities are far too complex for formula-driven approaches and good urban design requires a complex mix of quite different kinds of approach.*

-------- Kim Dovey 2016, Introduction p. 1

While cities are considered as Jacobs’ ‘organized complexities’, Deleuze and Guattari’s Assemblage or Rhizome or Salingaros’ urban web, each viewpoint implies a similar understanding of the built environment through a certain perspective as an epistemology. Such notion is further associated with a number of approaches that can create different morphologies to reflect it. In this research, the Areal thinking as discussed in Chapter Two shares a common ground with the Interconnection theory in Chapter Three. Although the former originated from the East representing an ‘Areal’ epistemology of the world, the latter is a collection of ideas from the West resulted from the paradigm shifts of understanding cities from Alexander’s tree to the semi-lattice structure.

In other words, they both reveal a comparable way of thinking that emphasizes the importance of multiplicity and interconnections of complexity in the urban structure. As a result, it leads to a similar understanding of the modern cities as a network of connections and interrelationships rather than seeing them as isolated silos as worshiped by the modernist planners and designers. This further indicates a key philosophical stance of this study, which is to understand the importance of interrelationships (Integration, Connection, and Interaction) between different parts of cities and that they precede any individual objects or buildings. Such similar understandings of the world correspondingly orientate a methodology that can be used to understand an urban structure in Eastern culture by using Western urban theories, and this is the main subject of discussion in this chapter.
This comparative study establishes a system of mixed methods that are inspired by the Interconnection theory (qualitative\(^1\)) and empirical studies (quantitative\(^2\)) as discussed in the previous chapter. The aim is to investigate the Eastern urban structure with a central question: **What are similarities and differences between the form and function of the Supergrid and Superblock Structure in Chinese and Japanese cities?** A mixture of methods is employed with qualitative investigation of four case studies as the primary approach supported by quantitative techniques as a supplementary review. It highly relies on the mapping and graphic analysis of existing physical conditions in cities, where first-hand data is collected through on-site investigations of four selected Superblocks in different cities. These methods also extend to design, which includes the experimental modifications of two study sites in an addendum. This provides an indicative model and methodology to improve the Chinese superblock structure by learning from its existing problems and from potential solutions from Japanese Superblock structures.

This chapter is composed of two major sub-sections. The first section discusses the philosophical stance, research paradigm and research questions of this study. It establishes and clarifies the purposes and theoretical basis of the research methodology. The second section introduces and explains in detail the research design and methods, which are used to investigate the Supergrid and Superblock structure. There are six stages of investigations, and they are used to generate informative maps that contain essential spatial logical systems and principles behind the scenes. At the same time, key definitions are also given in order to construct a framework of methods in the mapping and analysis of later chapters.

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\(^1\) Qualitative: first hand experiential observation and reporting; explorative in nature, offering a new perspective on the superblock study of modern Japanese cities.

\(^2\) Quantitative: Measuring the size, density, concentration and distribution of formal (e.g. street blocks, lots, buildings) and functional (activities/uses and movement/flows)
4.2. Research Philosophy and Theoretical Stance:

Chapter Two discusses Chinese and Japanese epistemology through Eastern Areal/lateral thinking. It emphasizes a spatial conception that constructs a network of connections between individual elements (see Figure 4.1 left). This is characterized by a multi-dimensional spatial conception that in turn affects the way in which cities are organized spatially and functionally as a multi-directional Supergrid and Superblock structure. Moreover, it is a counterpart to the Western mode of linear thinking that results in radial structures. In other words, the Eastern and Western epistemologies of the world are responsible for the formation of different urban morphologies.

Chapter Three also discusses a similar epistemology through a group of theories that understand a city as an organized complexity with a network of multiple connections and interrelationships. They see the production of modernist planning as a destruction of the urban system and claim to restore city structure by reconstructing the lost connections (see Figure 4.1 right).

Figure 4.1 – Two Diagrams indicate a similar way of understanding and thinking of the World/Epistemology of Space and Cities from the Eastern Culture (left) and from the Western Theory (right) in Conceptual Diagrams (left one is made by the author, the right one is from Salingaros 2005, p.8).
In other words, on the philosophical level, the Areal thinking in Eastern culture is tantamount to the gist of Jacobs’ complexity, Alexander's semi-lattice structure, Deleuze and Guattari’s Assemblage and Rhizome, Bentley et al.’s Responsive Environment, Gehl’s Space between Building and Arida’s Interference Model, Salingaros’ urban web and Marshall’s evolving ecosystem. In this sense, the nature and scope of two bodies of knowledge express the same kind epistemology of understanding cities from interconnection, multiplicity, and complexity, despite the origin of ideas from East and West; or from different cultures and physical structures of cities. Correspondingly, they also imply a clear ontology of cities: ‘differences (relationships) precede identities (things, objects) (Dovey 2016, p.78)’. Therefore, although it is seemingly inappropriate to use western theory as a theoretical stance to study the eastern urban structure, it is the most appropriate option because they share the same world-view of understanding cities.

On another level, the review of existing literature in Chapter Two and Three also indicates an interconnected and mix-and-match philosophical stance between subjectivism and objectivism, and between relativism and realism. The two doctrines of knowledge are related to the form and function of cities as indicated in the Interconnection theory, which concerns multiple connections and interrelationships. On the physical side, the understanding of the structure of cities requires objective observation of tangible forms because they are visible and measurable as solid facts. The review employs a quantitative mode of inquiry that relies on data collection to reveal the ‘one truth’ as presented. On the other hand, the investigation of urban functions, activities, and movements is an experiential, phenomenological or qualitative mode of inquiry that depends on subjectivism (Interpretivism/constructionism) and relativism as belief. Because of the nature of being a social and cultural subject, this approach usually presents multiple results depending on context. The study of the interplays between form and function, therefore, requires a fusion of realism and relativism, objectivism and subjectivism as the philosophical foundation.
Both inductive and deductive reasoning that are used in this study originate from objective observation and subjective experience (phenomenological and behaviouristic) of the Superblock structure. It is studied through theories and data collection (Interpretivism/constructivism) involving more than one method. It is a process of deduction-induction-deduction by making assumptions and correlations between numbers of logical questions from real life observation, followed by analysis of the traceable pattern and distribution, which can further be summarized as design principles. Similarly, the epistemology of this study is also both etic and emic because of the objective\(^3\) and subjective\(^4\) characteristics in nature. In other words, this study uses a Mixed Method\(^5\) as its research paradigm, which primarily responds to the qualitative methods with quantitative methods as a supplement.

While this is not a design research, one of the major purposes of this study is to understand the Supergrid and Superblock structure and how they perform in terms of facilitating or impeding social-economical functions in cities. In response, this study also contains a proposed urban model in conclusion. This includes experimental designs to demonstrate possible design solutions as an addendum to inform improved designs for China's future development. Unlike design research that is speculative and unpredictable, it can only generate and test a number of relatively unscientific urban scenarios 'because the context and future adaptations cannot be controlled (Dovey 2012, p.5)'. The design component in this study is a demonstration of the findings of the investigation of spatial logic embodied in Chinese and Japanese urban assemblage. They are generated from a number of underlying design principles that can be traced from existing patterns and distribution of urban form and function through investigative spatial techniques like drawing, diagramming and 3D modeling. The possible design solutions from this study are built more on a solid understanding of existing practices, which are more pervasive and predictable. In other words, the underlying theme of the study is that through the

\(^3\) Refers to facts in real life under different cultural context

\(^4\) Refers to assumed relationships between the initial problem and the Superblock structure

\(^5\) The use of two more methods in a research project to generate both qualitative and quantitative data can be considered as Mixed Methods paradigm (Hall 2012 & Teddlie & Tashakkori, 2009). Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems that either approach alone’ (Cresswell & Plano Clark 2007, p.5).
understanding the operational mechanisms of urban structure in China and Japan, the outcomes will improve and inform urban design in modern cities, with a particular interest in seeking design solutions for Chinese cities.

Finally, this research investigates the interrelationships between form and function of the Supergrid and Superblock structure where the Integration, Connection, and Interaction between the two generate synergies. It can also be seen as they are generated by the cooperation between density, type, and pattern of physical structure and the intensity, variety, and distribution of social functions. These are the key indicators for creating a good urban structure and generating synergies as discussed in Chapter Three. The research philosophy of this study is, therefore, about the way in which different interrelationships of a city are interconnected through its parts, or in Hillier's (1996) words, it is a city that makes places, not places make a city. The emphasis is on the importance of relationships between things, rather than on individual object.

This central idea of such an understanding of the world also affects the methods that will be used to investigate the interrelationships between form and function, and indicates that this study regards cities as networks of connections or organized complexity. The Supergrid and Superblock Structure in Chinese and Japanese cities are therefore analyzed through the lens of such epistemology and ontology by using a mixed method paradigm, which is also the philosophical stance of the methodology of this study.
4.3. Research Questions and Hypothesis

As comparative research, the major purpose of the study is to understand the similarities and differences of the Supergrid and Superblock Structure in Chinese and Japanese cities. This is also the central research question of this study. While the urban structure is strongly oriented by culture, it is also a direct product of economic development, which is understood from a philosophical stance that recognizes cities as systems and interconnections as discussed above. By understanding the interrelationships between form and function of this structure of cities from the two countries based on the Interconnection theory, the similarities and differences can be elucidated.

1. How does culture separately influence the Supergrid and Superblock Structure in Chinese and Japanese cities?
2. What are the morphological interrelationships between the form (street network) and function (functional use) in Chinese and Japanese Supergrid and Superblock structure?
3. What are the underlying design principles of Superblocks in Chinese and Japanese cities?
4. What are the structural and functional advantages and disadvantages?
5. How can we improve the Superblocks without compromising the culture?

In Chapter Two, although the number of existing studies about Supergrid and Superblock structure is limited, the number of related studies of Chinese and Japanese cities is abundant and they lead to an initial hypothetical assumption:

While the grid structure at the urban scale appears to be similar, at the scale of the individual Superblock, substantial differences exist between the two countries. The Superblocks in Japanese cities hypothetically work better in terms of the generation of convenience for the urban dweller, providing synergies as a system and which may inform structural improvements in Chinese cities.
4.4. Research Design and Methods

Due to variation in complexity across major cities, two pairs of typologically similar Superblocks from two Chinese and two Japanese cities have been selected as case study sites. Like many urban design studies, this research involves a more physical and visual understanding of the morphology and spatial structure of cities. While Urban Morphology and Urban Design are about ‘inferring’ and ‘expressing urban form-function relationship’ (Marshall and Caliskan 2011, p.1), the use of morphological mapping and analysis is used as the fundamental tool for this study to understand the complexity of this structure from its Integration, Connection, and Interaction as discussed in the previous chapter.

The design of this research method is built on an investigative process that goes through six stages (see Figure 4.2). They include:

1. Constructing a framework of mapping methods to identify the study focus based on Interconnection Theories and empirical studies from Chapter three;
2. Identifying study sites and applying qualitative and quantitative approaches to collect data and spatial information from selected Superblocks in field trips;
3. Converting the collected data into 2D and 3D drawings;
4. Analyzing and comparing the maps and data;
5. From the analysis, deriving key principles of Superblock structures that can better facilitate movement and generate activities.
6. Using the findings from 5 to propose a prototype model as part of the explanation of the conclusion and to modify the two selected Chinese Superblocks as experimental design in the addendum.

This investigation method can provide both theoretical and practical spatial responses to assist in answering the research questions. The experimental design is only an indicative test and also an example to improve the Chinese Superblock structure by learning from the problems of Chinese Superblock and
potential values of Japanese Superblock structures. Each stage will be explained in detail in the following sections.

Figure 4.2 – The Design of the Research in Six Stages
4.4.0. Identifying study focus:

Due to the complexity of the urban study, three things need to be clarified:
1) The focus of the study subject;
2) The emphasis of the physical and functional elements.
3) The application of a system of scale

4.4.0.1 The Study Focus: Superblock in the context of Supergrid

While this is a grid-and-cell structure that encompasses a substantial area of a city, it is important to have a focus because of the limited time and resources. One of the important messages from Chapter Two is how similarities and differences within Chinese and Japanese cultures can affect the formation of the Supergrid and Superblock structures. When Supergrids in the two countries are constructed similarly as multi-directional road networks, the morphology of each Superblock cell appears to be different. In other words, studies of individual Superblocks can reveal a greater understanding of the Supergrid system, and provide more insights to the understanding of the way in which the system works across differing scales. Therefore, this research chooses to focus on the investigation of selected Superblocks without losing the sight of the Supergrid as a whole system.

4.4.0.2 Emphasis on the Street Network and Functional Use

While there are many different elements in the physical and functional systems of cities, it is important to understand urban complexity from a more specific focus and contain the investigation of the complexities into a manageable study. At the same time, in order to prevent oversimplifying the complex problem into a problem of only two variables (which, as Jacobs suggests, is a common problem), the research explores interrelationships through a general understanding of the morphology of the selected sites, with an emphasis on street network and functional activity. The former can be considered as the generator of interplays, while the latter as a manifestation of synergies.
As discussed in Chapter Three, the street is a major determinant of urban structure and a generator of economic movement and activities in cities as Hillier proclaims. As part of the urban form, all the streets in cities together can form Salingaros’ urban webs and provide the physical structure for movement and activity in cities. The street is vital to the ‘life and death’ of cities as Jacobs emphasized. It defines cities with clear patterns (Marshall) and gives specific built form by shaping buildings as spines (Alexander and Salingaros). The street network is also studied in most empirical studies to understand its connectivity and permeability to different types of networks. Hence, the street network is given priority over other elements in the study of physical structure.

At the same time, the emergence and occurrence of activities are the major manifestations of urban synergy, and the places where activities take place are the major economic production and social foci that contribute to the liveliness of cities. This is affected by movements and by many other factors, such as rental price, population densities or the presence of major functional nodes (such as schools and hospitals), which can also generate movements as indicated in the empirical studies. Therefore more emphasis is given to the functional use of building and space, which can exhibit the overall level of activities and urban synergies.

In comparison to activity, existing theory suggests an intermediary role for movement. It is a force that contributes to the places where activities occur and accumulate, while it can also be affected by activities. As a functional use of the physical streets and space, the distribution of movement can be measured through the mapping of street networks. Empirical studies as discussed in Chapter Three indicate several major attributes of movement: travel mode, frequency, distance, and intensity. Travel frequency and distance are beyond the scope of this study because of the difficulties in data collection by one researcher in four different places. On the other hand, travel mode and distribution can be studied through on-site observation, and space syntax can provide some indicative predictions of the movement intensity.
Buildings too are important in the generation of movement and activities. They constitute the most direct physical elements that are able to transfer the spatial order and mechanism into tangible form and provide shelters and storage for people. In some sense, buildings are actually the indicators of where most activities take place, while the activities can also take place in spaces like streets, parks, and plazas. The distribution of activity can hence be measured through the distribution of those buildings where most activities take place.

4.4.0.3. The Application of Global-Glocal-Local-Internal Scale

While scale is a commonly considered major factor in all urban studies affecting the investigation of street networks and movement patterns, established urban design method of zooming in and out through different scales is often used as an important technique in analyzing the form and function of this Superblock structure. Integration is a key principle for understanding connections and interactions across different scales as discussed in Chapter Three. In Jacobs’ perception, Integration is about how the street network performs on the level of the street, district/neighborhood, and city. In Hillier’s theory, it is about how space is integrated between global and local scales. In the study of the structure of Japanese Superblocks, Shelton 2012 proposes two new concepts of scales following Hillier’s logic: the idea of 1) ‘glocal’, which means the streets that ‘are clearly less than global and more than local (p.155)’ and approximate to Jacobs’ district or neighborhood level; and 2) ‘Internal’ to describe those ‘oku-type’ of spaces in Japanese Superblocks that are hidden from the outside. It is equivalent to the interplay at street level as discussed by Jacobs and Gehl and represents a human level of connection and interaction. Hence, the Global, Glocal, Local and Internal scales are used in this study to describe the spatial structure as key measures with the assistant of space syntax. Dovey 2014 proposes a model at scales of 10m, 100m, 1km, 10km to understand the cross-scale relationship, which can be thought as the equivalent of the Internal, Local, Glocal and Global scale respectively. Moreover, some terms are used interchangeably to refer to the similar concept of scales in this study. For example, the local scale can also be
called as Superblock scale. The Glocal scale can refer to an area that is about the size of 9 Superblocks.

**4.4.1. Stage One: Constructing a Framework of Methods**

The first stage of the investigation is to construct a system of qualitative and quantitative mapping techniques as a method framework. It is derived from the studies as discussed in Chapter Three and provides a spatial analysis of the urban structure through a morphological and configurational approach. This can provide an understanding the basic form of selected Superblocks and how different elements are interconnected within the spatial and functional system. The design of the mapping method has three major sections for each case study (see Figure 4.3): the historical transformation, general morphology and the interrelationships (integration, connection, and interaction).

![Figure 4.3 – The Basic Method Framework for Each Case Study](image)
4.4.1.1 The General Morphology: Street and Activity

Major approaches in studying urban morphology can be classified into four types: spatial analytical, configurational, process typological and historico-geographical Kropf (2009, p. 109). This study uses the spatial analytical as the major approach with the other three as supplements. The first part of each case study is to understand how the physical and functional system works through the mapping of six measures of the street and activities. It can provide basic maps and data for later analysis of the interrelationship: Integration, Connection, and Interaction (see Figure 4.4). These are:

1. Maps that indicate how a Supergrid and Superblock structure has been formed through history and key structural characteristics that are influenced by Chinese and Japanese culture
2. Maps that indicate the density, type, and pattern of building and space, with particular emphasis on the street network.
3. Maps that indicate the distribution, variety, and intensity of movement and activities, with particular emphasis on activities.

![Diagram showing the method for mapping the general morphology of each selected Superblock.](image)

Figure 4.4 – The Method for Mapping the General Morphology of each selected Superblock.
4.4.1.2 The mapping of Street Network: Density, Type, and Pattern

4.4.1.2.1 Street Type

Street network is classified into four major types: Global Road, Glocal Street, Local Street and Internal Street, which represent different types of structural connection and also in response to related scales as discussed above (see Figure 4.5). This is adapted particularly from Hillier, Marshall and Shelton’s theories of street connection and their mapping techniques. Each type is illustrated through maps, street sections, and photos to indicate how different street types are connected to each other (Alexander 1965 & Salingaros 2005), and how streets affect the general built form of Superblocks (Bentley et al. 1986 & Shelton 2012).

Global Road: Mainly refers to the wide arterial roads that form the Supergrid. They are normally more than 25m wide and go further than 5km flanked by sidewalk streets on both sides that carrying pedestrian movement and serving more social activities. They often overlap with subway lines, elevated highways, bridges, underground tunnels and all kinds of multilevel connections.

Glocal Street: Mainly refers to the streets that connect neighboring Superblocks. They are normally less than 24m wide and go no less than five neighboring Superblocks with crossings. This study considers the sidewalk streets along Global Roads as part of the Glocal street network on a theoretical level but excludes them in the analysis to avoid the iteration and confusion as they run alongside with the Global roads.

Local Street: Mainly refers to the streets within a superblock that create direct access to global roads at the edges, but do not go across the global roads into its neighboring Superblocks, they are typically less than 15m in width.

Internal Street: Mainly refers to the local streets that do not directly connect to the edges of a Superblock providing internal links within Superblocks. The widths and lengths of them vary in different Superblocks, but they are typically less than 10m in width.
A diagram showing different types of street and junctions. The diagram includes:

- **Global Roads**: Red lines indicating major roads.
- **Glocal Streets**: Orange lines indicating regional streets.
- **Local Streets**: Yellow lines indicating local streets.
- **Internal Streets**: Blue lines indicating internal streets.

A table labeled "Types of Intersection*" shows the distribution of these types:

<table>
<thead>
<tr>
<th></th>
<th>Global</th>
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<tr>
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<td>Glocal</td>
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<td>Local</td>
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* Intersection: In this thesis, the use of intersection refers to cross-intersection as indicated in the diagram.

An example (Shelton 2012)
Figure 4.5 - Mapping Method for Street Network: Types of Street and Junctions
4.4.1.2.2 Road/Street Density

As widely discussed and used in many empirical studies in Chapter Three, two quantitative measures are used in this study to indicate the density of the street network of selected Superblocks as a supplement to the spatial maps. They can provide a quantitative explanation for each street type and how extensive each street type is in a street network of a Superblock.

1) The Density of Road/street network:
Street Density = Length of the Street (km)/Size of the Study Area (km²)
(Empirical studies in Chapter 3, Hawbaker et al 2004).

2) The Density of Junctions (T-sections or Cross-Intersections):
Density of Junctions = Number of Junctions (No.)/ Size of the study Area (km²)
(Cervero and Kockelman 1997; Greenwald and Boarnet 2001; Lee and Moudon 2004; Frank et al 2005; Parks and Schofer 2006; Kerr et al 2007;)

4.4.1.2.3 Street Pattern

The mapping of street networks of the selected Superblocks as a network of lines is derived from the methods from Bentley et al. 1986, Hillier 1996, Salingaros 2005, Marshall 2005 and Shelton 2012. This includes three types of maps:
1) Map the street pattern into two major categories: the grid and tree (cul-de-sac and loop) according to Marshall (2005)'s classification
2) Map the number of connections of to their surrounding area (Bentley et al. 1986 & Shelton 2012);
3) Map the structural connections between different levels: underground, ground and above ground level (Shelton 2012);

4.4.1.3 The mapping of Social Activity: Intensity, Variety, Distribution

Human activities are by nature extremely complex and dynamic. ‘The more richly intermixed the functions of a neighborhood, the more difficult they are to
map – good cities and districts resist functional mapping’ (Dovey 2016, p.26). This means that it is hard to make a clear and useful categorization. For example, a shop house can be considered as having three major activities: shopping, working on the ground floor and living on the second floor. It could also be thought as a mix of commercial/retail and residential use in planning. In other words, there are many different ways of categorizing activities, ‘how we slice this cake depends on what we want to know about the city’ (ibid). As discussed in Chapter Three, this study investigates the socioeconomic forces of cities. Hence, the categorization of activities is based how well cities can generate a greater level of synergy and convenience for social activities.

### 4.4.1.3.1 Activity\(^6\) Distribution

Inspired by the triangle model of Hoek (2008), Nes, Pont & Mashhoodi (2012) and Dovey (2014) and also by Jacobs’ theory, this research creates a Triangular Function Mix Model, which classifies different social activities into four major functions (see Figure 4.6). Each type of social activity further contains a number of building programs, which are color-coded and used to convert data into maps to show the spatial distribution of activities and the mixes of uses within Superblocks. The four categories together create a functional system to map the different uses of space/types of activities. The following gives a definition for each type.

**Consumption Activity:** represents a number of wealth-using activities that are related to the use of any commodity or service in cities. It is the most fundamental social activity that takes place in cities. This includes all kinds of shops and stores, restaurants, and entertainments etc.

**Production Activity:** represents a number of wealth-creating activities (both physical and intellectual) that are related to the creation of any commodity, service or information in cities, including all kinds of companies, factories, and manufacture etc.

\(^6\) Unlike Halprin’s (1969) RSVP approach of studying activities, this study mainly investigates the activity distribution.
**Service Activity**: represents a number of activities that are related to the assistance of consumption, production or living. It is mainly about the non-profit oriented social service. This can include all kinds of hospitals, schools, hotels, banks and public services etc.

**Residence**: represents a number of activities that are related to living and residing, including all kinds of apartment and houses.

The mapping of the distribution of activity is to record how the above four functions are distributed horizontally and vertically within each Superblock by mapping the use of building (Jacobs 1961 & Dovey 2016). The mapping of the horizontal use of the building is to indicate the distribution of activities on the ground level. The mapping of the vertical use of the building is to indicate the distribution of activities on different floors, and they can create four combinations of different functions, including Consumption+Production; Consumption+Service; Production+Service; and Consumption+Production+Service; The locations of these combinations indicate how they are spatially distributed, and the way in which they are recorded and indicated in maps. Each type of activity is indicated on maps to show their spatial distribution at Glocal, Local and Internal scale (Jacobs 1961 & Shelton 2012).

**4.4.1.3.2 Activity Variety**

The variety/diversity of the categories of Consumption, Production, Service, and Residence are furthered mapped according to the actual use of each individual building on different floors. This is to show how diverse the above four major functions of modern cities can be in terms of building uses. Each function includes a number of different building uses that are indicated on maps to show the variety in both the horizontal and vertical dimension. The horizontal mapping indicates what the ground-floor uses of buildings are; the vertical mapping indicates the floor spaces which are used on different levels. This mapping can indicate the level of mixed uses of the buildings and the functional diversity within Superblocks (Jacobs 1961, Bentley et al. 1986 and Gehl 1987).
Figure 4.6 – Mapping Method for Social Activity: A Triangular Functional Mix Model
### 4.4.1.3.3 Activity Mix Intensity

The mapping of the intensity of activity includes all the activities that can be found at both the horizontal and vertical level. They are also mapped by using the four categories with a mapping technique that is created for this purpose. Horizontal intensity indicates how different activities are mixed together in every 50m by recording the ground floor use of buildings within each study area (see Figure 4.7 at the bottom). The vertical intensity illustrates how concentrated different categories of activities are located by mapping within each building (see Figure 4.7 on the top).

![Mapping Method for Creating Maps to Indicate the level of Intensity](image)

**Figure 4.7** – Mapping Method for Creating Maps to Indicate the level of Intensity
4.4.1.4 Other Morphological Elements: Building and Movement

Although this study specifically emphasizes the street network and functional activity as the major study subjects, it does not mean that other urban elements are ignored in the process of investigation. In order to contain and specify the research subject, the other elements are discussed whenever they are necessary for the understanding of the street network and functional activity. On one side, the mapping of the distribution of activity is based on the location of buildings in each Superblock. This means that activity maps also correlate the density, type, and pattern of buildings to various degrees. On the other side, the mapping of the pattern of street networks is based on all the publicly accessible paths. This means that all private inaccessible paths are not included in the street network maps. The mapping of movement can compensate this shortage, because it records all modes of traffic that includes both the public and private space within the study areas. For both movement and buildings, they are also investigated within the framework that applies to the street and activity. Building types, density, pattern and movement distribution, variety, intensity are also mapped when they are necessary to supplement the study of the street network and functional uses.

As a supplement to street network, movements are investigated through:

- The variety of movement indicates four different travel modes: walking, cycling, driving and public transportation. The mapping of movement hence is to map the publicly accessible pattern of movement within each selected Superblock.

- The intensity of the movement is mostly based on the phenomenological observation of the existing use of space, the limited data collected by the researcher, and the experience of living there.
• The mapping of the distribution of movement is to record all channels for movements that are both publicly and privately accessible for either people or automobiles.

As a supplement to functional activity, built form is investigated through:

• The mapping of building types is to record all the buildings that are located within the study area in 3d model and Figure Ground Maps. They are categorized into different physical configurations: pavilion (point), row (line), courtyard (area), tower, slab and perimeter block based on the classification from Lerup 1976 and Dovey 2016.

• The mapping of building density is based on two important figures that are commonly used in urban design and planning studies and practices: 1) Building/Site Coverage indicating the percentage of the built up area in proportion to the area of the selected Superblock; 2) The Floor Area/Space Ratio (FAR/FSR) indicating the total built floor area in proportion of the selected Superblocks (Dovey 2016, p.32).

• The mapping of Building Pattern is based on Maki’s theory of Collective form, which categorizes buildings into three major patterns: Compositional, Megastructure, and Group. (Maki 2008, Nordic Journal of Architectural Research 2014).
### 4.4.1.5 Mapping Methods for General Morphology Summary

#### Form

<table>
<thead>
<tr>
<th>Density</th>
<th>Street</th>
<th>Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Space Ratio</td>
<td>Open Space Ratio and Open Space Coverage</td>
<td>Population Density</td>
</tr>
<tr>
<td></td>
<td>Street Density</td>
<td>Building Coverage</td>
</tr>
<tr>
<td></td>
<td>Junction Density</td>
<td>Floor Area Ratio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Maps &amp; Statistics)</td>
</tr>
<tr>
<td>Pattern</td>
<td>Street and Block Layouts</td>
<td>Figure Ground/Nolli Maps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lerup 1976 classification map</td>
</tr>
<tr>
<td>Type</td>
<td>Street Sections Diagrams</td>
<td>Maki's Group Theory Map</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Building Sections (Illustrations)</td>
</tr>
</tbody>
</table>

#### Function

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Distribution Maps (Building and Space Uses on</td>
<td>Space Syntax</td>
</tr>
<tr>
<td></td>
<td>different levels of building across</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the whole site)</td>
<td></td>
</tr>
<tr>
<td>Variety</td>
<td>Variety Maps (Specific uses as classified on</td>
<td>Pedestrian Flow</td>
</tr>
<tr>
<td></td>
<td>different levels of building across</td>
<td>Bike Flow</td>
</tr>
<tr>
<td></td>
<td>the whole site)</td>
<td>Car Flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public Transport Network</td>
</tr>
<tr>
<td>Intensity</td>
<td>Intensity Maps (Horizontal &amp; Vertical Mix</td>
<td>Transport Stations Maps</td>
</tr>
<tr>
<td></td>
<td>Intensity)</td>
<td>Space Syntax</td>
</tr>
</tbody>
</table>

Table 4.1 - Mapping Methods for General Morphology – explaining the mapping methods that are used for collecting data for this research
4.4.1.6 The Interrelationship: Integration, Connection, and Interaction

Through superimposing maps of the street network (types, density, and pattern) with maps that indicate activities (distribution variety, and intensity) of selected Superblocks as indicated in table 4.1 above, it is hypothesised that this will reveal how the form and function of the Supergrid and Superblock structure work with each other in modern cities. This includes three major sections:

- Integration Maps, which reveal the interrelationship between the spatial arrangement, movement, and activity according to Space Syntax analyses.
- Connection Maps, which show the superimposition of maps of density, type, and pattern of the street network with four types of activities as one color (from black to grey).
- Interaction Maps, which demonstrate the overlapping of maps of distribution, variety, and intensity of activity mix with street networks as one color (from black to grey).

4.4.1.6.1 Integration: Space Syntax Analysis

Integration can be measured by using Hillier’s space syntax maps, which are created according to the spatial structure of the selected Superblocks. Hillier indicates that the structure of the urban grid as a pure spatial configuration is closely related to land use patterns, building densities and mixing of uses in the urban area and part-whole structure of the city (Hillier 1996, p.152) embodies the ‘movement economy’. In other words, space syntax maps can represent the pattern and intensity of movement and activity as a distribution of synergy. Using space syntax as a tool to investigate the structure of selected Superblocks can indicate how well this structure is integrated across different scales. It can further show how the city street network as a whole is integrated through the constitution of different parts, and how physical structure, movement, and activity are related to each other in selected Superblocks.
Space Syntax is used to understand the space-to-function relationships by analyzing the spatial configuration of the Supergrid in each city the study Superblock at four levels: the whole city, the Supergrid (Global scale), the study site and its eight neighboring Superblocks (Glocal scale), and the Superblock (Local scale): these are analyzed in terms of their Global integration (R=n) and/or Local integration (R=3). They produce four groups of analytical of Integration/space syntax maps:

1) A map that illustrates the whole city network
2) A map that illustrates the Supergrid only
3) Two maps that illustrate the street network in the area of nine Superblocks
4) Two Maps that illustrate the street network within each Superblock

**4.4.1.6.2 Connection:**

Connection as discussed before implies the importance of both physical and functional connection: the physical connection that provides structural advantage for the functional mix in proximity. In order to understand the connection as the second important interrelationship, the mapping method is to superimpose different type, density and pattern of street network maps with functional activity maps (including all the activities as one color) to see how the street network is related to the location of different activities in the study sites.

There are three types of Connection maps:
1) Maps that show the street patterns with the distribution of all activities
2) Maps that show street types with the distribution of all activities.
3) Maps that show street density (junctions) with the distribution of all activities.

Four key numerical measures are used to assist the understanding of the Connection maps.
1. Total number of activities along each street type
2. Activities per street = Total number of activities along each street type /number of streets of each type
3. Activities per street length (km) = Total number of activities along each street type/total lengths of each type of street
4. Activities per street density (km/km²) = Total number of activities along each street type/street density of each street type

The first measure shows the number of activities in relation to each type of street network as one entity. The other three measures successively show the activity density along each type of street.

4.4.1.6.3 Interaction:

Interaction as discussed in Chapter Three is the co-functions and the ‘mix of mix’ of different functions that benefit from the structural proximity and advantages. Jacobs’ mix of different sizes, types, ages of buildings and other physical structures in its essence is to provide shelter to accommodate a wide variety of functions and allow them to mix through the assemblage of small (a convenience store) and large (shopping mall) buildings. Therefore, Interaction refers to both physical and functional interaction interplay in proximity and mix. It mainly manifests itself as socio-functions through the variety, intensity, and distribution of movement and different activities. It is the interaction between people building and space with a focus on how different functions are mixed together to serve people through physical forms.

Similar to Connection, the mapping of this interrelationship is to superimpose maps that record different variety, distribution, and intensity of activities with four types of street networks. This can show how the co-functioning of activities is related to the pattern of the street network.

This also includes three groups of Interaction maps:
1) Maps that show the distribution of activities mix with all streets.
2) Maps that show the variety of activities mix with all streets.
3) Maps that show the intensity of activities mix with all streets.
Because the number of activities is countable and observable directly from the maps, no numerical measure of activity density is used. Only the total number of activities of each type of street network is measured to assist the understanding of distribution patterns of the activity mix.

4.4.2. Stage Two: Data Collection and Fieldwork:

The second stage is to collect data of the general morphology of the study sites. This includes site observation, photo documentation, measurement, recording and map collection from local libraries, online digital map libraries and local government resources.

4.4.2.1. Comparative Case Study and Site Selection:

The second stage of the investigation is to collect firsthand data from selected sites. Four sites in different cities are chosen for case studies to analyze the spatial and structural differences. Xi’an and Nanjing are selected as representatives for Chinese cities, and they are paired with Kyoto and Osaka respectively. One Superblock is selected from each city for site investigation and morphological mapping, including a brief historical exploration of the changing morphology of the background. The four sites are selected based on the criteria listed below; they are Jinyuan and Daguangli from China, and Shijo-Karasuma and Imazato from Japan (see Figure 4.8).
Figure 4.8 – The Four Selected Sites and Cities (adapted by author from Google Map 2016)
4.4.2.2 Criteria for site selection:

The two pairs of sites are selected according to the criteria as listed below:

1. Each pair of sites should try to be approximately of the same size, although sometimes one of them might be larger or smaller (±20%).
2. One pair should be in the inner area of a Supergrid, and the other pair should be on the edge of a Supergrid to show how locations of the Superblocks in Supergrids can affect the morphologies of Superblocks.
3. They should both be 'typical' and representative types of Superblock in Chinese and Japanese cities.
4. There should be similar geographical conditions within each pair (e.g. a river, a railway, undulating surfaces etc.)

4.4.2.3 Required Data for Study:

According to the method framework as indicated in stage one, both qualitative and quantitative data that are needed to create maps can also be divided into two parts: the density, type and pattern of street network and the distribution, variety and intensity of functional activity. The required data is listed in the table below (see Table 4.2):

<table>
<thead>
<tr>
<th>Form</th>
<th>Building</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Total Floor Area and Land Area</td>
<td>Street Width and Length</td>
</tr>
<tr>
<td>Pattern</td>
<td>Built Form Map</td>
<td>Road and Street Maps</td>
</tr>
<tr>
<td>Type</td>
<td>Cadastral Map, Observation &amp; Photos</td>
<td>Cadastral Map + Observation</td>
</tr>
</tbody>
</table>
### Function

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Ground Floor Building Program</td>
<td>Traffic observation &amp; counting</td>
</tr>
<tr>
<td>Variety</td>
<td>Types of Building Program</td>
<td>Photos &amp; Transport Map</td>
</tr>
<tr>
<td>Intensity</td>
<td>Building Programs on Different Levels</td>
<td>Photos and Recoding</td>
</tr>
</tbody>
</table>

Table 4.2 – Required Data for Creating Maps

### 4.4.2.4 The Method of Data Collection:

As a morphological study of cities, this study adopts the commonly used method to collect the required data from maps, city plans, field surveys and books (Sanders and Woodward 2014, p.3). Aerial photography, digital interactive maps online and GIS systems are appropriate and direct sources of data for morphological studies on large scales (ibid and Pauleit and Breuste 2011, p.22), and they are suitable as the sources of data to investigate the current condition of the selected Superblocks for this study. For collecting the data of individual buildings at the smallest scale or the micro-morphology, plans, sections, and elevations of building and streets can normally be sourced from local authorities (Chen 2012, p.131, Larkham 2006, p.121&126) or universities.

Moreover, because each case study also includes a brief investigation of the historical transformation, it is necessary to adopt the ‘historico-geographically informed townscape analysis’ to understand the complexity of an urban structure and its present morphological characteristics (Conzen 2004, p.53). Historical photographs (both aerial and perspectival), maps and archaeological documents are important sources of data ‘when accounting for evidence of structures no longer available for in-situ observation’ and ‘assessing the historical streetscape’ (Sanders and Woodward 2014, p.3 & 6). Different methods for data collection are indicated in table 4.3.
Form

<table>
<thead>
<tr>
<th></th>
<th>Building</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Observation &amp; FAR</td>
<td>No. of Street &amp; Junction</td>
</tr>
<tr>
<td>Pattern</td>
<td>Figure Ground &amp; BC</td>
<td>Route Structure</td>
</tr>
<tr>
<td>Config</td>
<td>Maki’s Group Theory</td>
<td>Junction/Space Syntax</td>
</tr>
</tbody>
</table>

Function

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Observation and Recording</td>
<td>On-site Counting</td>
</tr>
<tr>
<td>Variety</td>
<td>Photos and Recording</td>
<td>Photos and Recording</td>
</tr>
<tr>
<td>Intensity</td>
<td>Photos and Recording</td>
<td>Photos and Recording</td>
</tr>
</tbody>
</table>

Table 4.3- Method for Data Collection

4.4.2.5. Resource Access:

The principal access to the listed data is through government sources, archival research, site survey, observation and miscellaneous websites. The goal is to provide raw data for mapping and analysis for this study. The possible places where data available are:

- Urban Development or Planning Authorities:
  Data about built forms (e.g. building height), road and street networks, land use maps, census data, planning maps and regulations and transportation network maps.

- National Library and Local Libraries in the selected Cities: Historic maps, and descriptions of the selected Superblocks in the City Year Books. Their built forms, land uses and street structure. Searching for the city, district and local site maps, architectural or planning history books.
• Websites and Online data:
  1. Official city website: for historic and contemporary maps and data about the form and function of the selected sites.

  2. Google search: Google map (for Japanese cities) and Baidu map (for Chinese cities) will be used for first stage observation and mapping before site visits, including built form, spatial arrangement, road and street structure, land and building uses.

  3. Access to several software sources, particularly Space Syntax and ArcGIS. These are accessible and available online.

• Fieldwork and Observation:
  Collect and also confirm data that is collected from local libraries, websites and related authorities. There will be photographic documentation and on-site drawings, and also video recording of how people use the spaces within the selected superblocks.

4.4.3 Stage 3. Converting Data into Morphological Maps

The third stage is to convert the collected data and spatial information into two groups of maps by using the mapping techniques that have been developed in Stage One. The two groups of maps are:

1) Morphological Maps that can be used to understand the General Morphology of each selected Superblock:
   - Historical transformation of selected Superblock
   - Street Type, Density and Pattern maps

---

All data are gathered during this Ph.D. study by the author, no data from other studies are used in this thesis.
- Activity Distribution, Intensity and Variety maps
- Building Type, Density and Pattern maps
- Movement Distribution, Intensity and Variety maps

2) Interrelationship Maps that show Integration, Connection and Interaction between the street network and social activities, including:
- Maps that show the level of integration as Space Syntax Maps;
- Maps that show the relationship between different type, density, and pattern of Street Networks with all the activities as background.
- Maps that show the variety, intensity, and distribution of Functional Activity with all the streets as background.

4.4.3.1 Data Conversion Principles:

General Morphology: Maps that record single layer of Information

The first group of map records density, type and pattern of street network and distribution, intensity and variety of functional activity as single layers. Because of the different structures that have been found in Chinese and Japanese Superblocks as indicated in the literature review and from fieldwork investigations, the same rules are applied to create comparable maps.

Street Network System

For Chinese Superblocks:

Extensive wall and gate structures exist in Chinese Superblocks. They are both physical structures that link buildings and space together, but also control the flow of traffic and people by separating streets as publicly accessible or inaccessible. Although they are not part of the street network, they are a still inseparable part of it. However, this structure does not exist in the two selected Japanese Superblocks, and the mapping of the street network, therefore, cannot show the wall structure directly for a comparable reason. The gates of each
walled compound are recorded according to their level of connection following the same rule as the four types of streets as indicated above. The wall and gate structure can, therefore, be converted into local cul-de-sacs, local cul-de-sacs, and internal cul-de-sacs. For example, a gate on global roads can be classified as a local street (cul-de-sac) if it connects the global road without a crossing to connect the two side of the global road. This gate is mapped as part of the local street network and indicated as a node on maps. The streets within the walls are also classified as publicly inaccessible streets that are not included in the street network, but in the maps that show a different type of movement (by people, car or bike). The data of street type is converted into maps according to the color-coding system as indicated below in table 4.4:

<table>
<thead>
<tr>
<th>Street Types</th>
<th>Color Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Roads</td>
<td></td>
</tr>
<tr>
<td>Glocal Street as global sidewalk streets</td>
<td></td>
</tr>
<tr>
<td>Global Street</td>
<td></td>
</tr>
<tr>
<td>Local Cul-de-sac</td>
<td></td>
</tr>
<tr>
<td>Local Street</td>
<td></td>
</tr>
<tr>
<td>Internal Cul-de-sac</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4 – Color coding system for Street Types in Chinese Superblocks

For Japanese Superblocks:

The two selected Japanese Superblocks do not have the same kind of wall and gate structure as found in the Chinese Superblocks. The street network is therefore relatively much less affected by a wall and gate structure. However, similar residential enclaves can also be found in Japanese superblocks but on a much smaller scale (see Table 4.5). Some are indicated as public owned streets while some are indicated as privately owned in planning regulation maps. For those publicly inaccessible streets, they are indicated as cul-de-sacs with the same rules that apply to differentiate four types of streets. Those private streets
that are accessible to the public are considered as part of the street network. The data of street type is converted into maps according to the color-coding system as indicated below in the table 4.5:

<table>
<thead>
<tr>
<th>Street Types</th>
<th>Color Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Roads</td>
<td>![Global Roads Color]</td>
</tr>
<tr>
<td>Glocal Street as global sidewalk streets</td>
<td>![Glocal Street as global sidewalk streets Color]</td>
</tr>
<tr>
<td>Global Street</td>
<td>![Global Street Color]</td>
</tr>
<tr>
<td>Local Street</td>
<td>![Local Street Color]</td>
</tr>
<tr>
<td>Internal Street</td>
<td>![Internal Street Color]</td>
</tr>
</tbody>
</table>

Table 4.5 – Color-coding system for Street Types in Japanese Superblocks

**Social Activity**

Unlike the physical structure, functional activity in studied Chinese and Japanese Superblocks are found to be similar and they can be classified into the four categories as indicated in the method framework. Different social activities are mapped to see how they are distributed and grouped both horizontally (ground floor use) and vertically (within buildings on different levels).

The data of the distribution of the four types of activities are therefore can be converted into maps according to the color-coding system as indicated below (see Table 4.6):

<table>
<thead>
<tr>
<th>Activity Distribution</th>
<th>Color Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consuming</td>
<td>![Consuming Color]</td>
</tr>
<tr>
<td>Producing</td>
<td>![Producing Color]</td>
</tr>
<tr>
<td>Servicing</td>
<td>![Servicing Color]</td>
</tr>
<tr>
<td>Residing</td>
<td>![Residing Color]</td>
</tr>
<tr>
<td>Consuming + Producing</td>
<td>![Consuming + Producing Color]</td>
</tr>
<tr>
<td>Consuming + Servicing</td>
<td>![Consuming + Servicing Color]</td>
</tr>
<tr>
<td>Producing + Servicing</td>
<td>![Producing + Servicing Color]</td>
</tr>
<tr>
<td>Consuming + Producing + Servicing</td>
<td>![Consuming + Producing + Servicing Color]</td>
</tr>
</tbody>
</table>

Table 4.6 – Color-coding system for Activity Maps
The data of the variety of the four types of social activities can be converted into maps according to the color-coding system as indicated below (see Table 4.7):

<table>
<thead>
<tr>
<th>Activity Variety</th>
<th>Color Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>All kinds of Restaurants</td>
<td>🔴</td>
</tr>
<tr>
<td>All kinds of Shops and Stores</td>
<td>🟡</td>
</tr>
<tr>
<td>Schools</td>
<td>🟢</td>
</tr>
<tr>
<td>Hospitals</td>
<td>🔵</td>
</tr>
<tr>
<td>Factories</td>
<td>🟣</td>
</tr>
<tr>
<td>Banks</td>
<td>🔴</td>
</tr>
<tr>
<td>Gas stations</td>
<td>🔵</td>
</tr>
<tr>
<td>Convenience store</td>
<td>🔴</td>
</tr>
</tbody>
</table>

Table 4.7 – Color-coding system for building uses maps (these colors are only indicative example, and it is not a full list of all building uses for mapping. Please see the full legend on each map in the four case studies in Chapter 5 and 6)

The data of the intensity of activity is converted according to four general types of activities, and they are converted into maps with a graded color-coding system: Low, Medium and High and Very High, four level of intensity (see Table 4.8). This mapping only includes the activities that take place within buildings.

<table>
<thead>
<tr>
<th>Activity Intensity</th>
<th>Color Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Type Activity (Low)</td>
<td>🔴</td>
</tr>
<tr>
<td>Two Type Activity (Medium)</td>
<td>🟡</td>
</tr>
<tr>
<td>Three Type Activity (High)</td>
<td>🟢</td>
</tr>
<tr>
<td>Four Type Activity (Very High)</td>
<td>🔵</td>
</tr>
</tbody>
</table>

Table 4.8 – Color-coding system for Intensity Maps
4.4.3.2 Interrelationship: Maps that record two layers of information

4.4.3.2.1 Integration Map: The Space Syntax

As discussed in stage one, Space Syntax is used to create Integration Map as a mapping method. In converting spatial information into Space Syntax map, street networks are converted into Axial Line maps. An axial line is a line in a network of all lines. They are drawn in a specific way by intersecting with each other if they are connected from the view of how humans perceive and move through space. They are the longest possible axis as a simplification of street spaces, which are formed as convex spaces (Hillier 1996). This is built on the theory of natural movement that follows a ‘least angle’ path between origins and destinations by minimizing the angular deviation between the two (Space Syntax Limited 2017). They can further be calculated to generate space syntax maps and data according to their relationship in the whole system to see how each one of them is integrated within a street network. Different colors are applied to each one of them to indicate how well they are integrated.

In this study, axial line maps are created by the researcher using Hillier’s theory and the rules above. These maps are then imported to the Space Syntax software (UCL Depthmap) for qualitative and quantitative analysis to indicate some spatial characters of the selected Superblocks. While the axial line map indicates how spaces are configured to each other syntactically following the geometric and mathematical rules, they need be drawn strictly based on their geometric relationship to each other rather than by physical connectivity. A complex space without direct visual connection across its length is not recognized by analysis as an axial line. It is therefore broken into two. Although the software is also able to generate axial line maps from block structure, it cannot distinguish the space for movement from open spaces or river channels. Therefore, this study has created these maps through hand drawing and selection, which has made the results more accurate and site specific. The results of the maps show a number of intersected lines that are in different colors (red to purple), which represents a
synergy distribution and intensity of natural movement that is created purely by the structural configuration of the Supergrid and Superblock.

There are many measures that are used in Space syntax analysis and different measures target different aspects of spatial structure. For this study, Integration is measured by using some important datum figures in the software that correlates to the concept of depth. Global and local integration measures are mainly used in the four case studies with the supplement of two other measures: connectivity and global/local integration mean. For the street network on a different level, global and local integration measures are applied selectively according to their nature.

Integration Maps:

- Map the whole city street network by using global (R=n) and local (R=3) integration measures
- Map the Supergrid by using global integration (R=n) measure only
- Map the streets within the area of nine Superblocks with the study sites in the middle by using R=n and R=3 measures
- Maps the streets within selected Superblock by using R=3 measure only

When R=n and R=3 are both measured, a scatter plot is used to show the level of global-local integration as suggested by Hillier’s study. The more the dots are concentrated to form a line in a scatter plot, the higher the global-local integrate a network has and vice versa (see Figure 4.9).

![Strong Global-Local Integration](image1)

![No/Weak Global-Local Integration](image2)

Figure 4.9 – Examples of Scatter Plots showing Different Levels of Integration
4.4.3.2.2 Connection Maps: Street Network and Social Activity

As the second principle of interconnection as discussed in theory chapter, Connection Maps are created to indicate how different types of street in essence represent different types of connection in relation to different social activities. In order to convert maps to show the connection between form and function, maps that show a different type, density and pattern of street network are superimposed with maps, which record consumption, production, service and residential functional uses/activities. It reveals how more specific use of building programs are related to different types of streets (see Figure 4.10). Those maps contain two layers of information and therefore can reveal certain correlations that formulate structure-movement-activity interplays.

This includes three types of map:

1. Superimposing street type maps (indicating Global-Glocal-Local-Internal four types) with maps that record different types of functional activity.
2. Superimposing street density maps (indicating intersections and T-junctions) with maps that record all functional activity in one color as the background.
3. Superimposing street pattern maps with maps that record different uses of buildings on ground level.

For instance, this includes analysis of the critical intersections to see what functions gather around them. An example was indicated by Shelton (2012), when he showed through mapping that *konbini* (convenience store) is almost always associated with Global-Glocal road intersections, indicating the interrelationship between land use and road structure. This implies other structure-movement-activity relationships to be discovered in the superblocks.
4.4.3.2.3 Interaction Maps: Street Network and Functional Mix

Similar to Connection maps, Interaction maps are also created to indicate how different street types in a network are related to different functional ‘Mix of mix’. Those maps also contain two layers of information that are related to the physical and functional system of each selected Superblock. By overlapping maps that illustrate the Distribution, Variety, and Intensity of Functional Mix with maps that record all streets within each selected Superblock, it can demonstrate some interrelationships that form structure-movement-activity interplays (see Figure 4.11).

1. Overlapping activity distribution maps indicating the four categories of activities in a map that records all street types, namely, the horizontal and vertical distribution of consuming, producing, servicing and residing.
2. Superimposing activity variety maps (indicating specific building uses like stores, restaurants, factories, schools, hospitals, convenience stores and petrol stations on both horizontal and vertical levels of all buildings) with a map that records all street types in one color.
3. Superimposing activity intensity maps (indicating both horizontal and vertical intensity) with a map that records all street types in one color.
4.4.4 Stage 4: Data Analysis

The fourth stage is to analyze the interrelationships through Integration, Connection, and Interaction maps of the selected Superblocks. This process can generate some findings to understand how the street network and activities are related to each other. The analysis of the interrelationships between form and function also draws on the theories as references and also identifies whether there are clear patterns of relationship between the two. Maps of integration, connection, and interaction all provide clear qualitative visualization of the interrelationships. Quantitative data is also produced through the analysis as a supplement to explain the patterns that can be directly or indirectly observed through maps.

Three methods are used to convert qualitative information into quantitative data in the process of analysis: machine counting and visual inspection by the researcher. While Space Syntax software is used to calculate the integration value for $R=n$ and $R=3$, machine counting is used to convert Connection and Interaction maps into vector shapes and lines as AutoCAD files, these are then
calculated through ‘Aream’ and ‘TLEN polylines’ programs that can count the number of shapes along different types of streets and the percentage of each type of activity. These calculations were used to understand the patterns and to determine which pattern is stronger. Visual inspection is also used to make the selection of shapes for counting by the researcher correct. These can reveal some interrelationships between the street network and functional use/activities:

**Global Form-Function:**
What are the uses/activities distributed across Global networks/roads?

**Glocal Form-Function:**
What are the uses/activities distributed across Glocal networks/streets?

**Local Form-Function:**
What are the uses/activities distributed across Local networks/streets?

**Internal Local Form-Function:**
What are the uses/activities distributed across Internal networks/streets?

### 4.4.5 Stage Five: Discussion of Findings

The fifth stage of the research is to discuss and summarize the main findings from the previous analysis. It includes the discussions that compare the two Chinese and Japanese Superblocks. This can answer the research questions as identified in 4.2.1.

#### 4.4.5.1. Comparing the Chinese Superblock

This section first summarizes the main findings on Chinese superblock structure. It includes the findings of major characteristics of the street network and social activities of the two selected Chinese superblocks, and how they are related to each other through integration, connection, and interaction. Some comparisons
between the two selected Superblock from Xi’an and Nanjing are made. Some basic design principles and limitations of the typical Chinese superblock structure are also concluded at this stage and these affect the next stage of research design. This answers the research question No. 2.

4.4.5.2. Comparing the Japanese Superblock

Similarly, main findings on Japanese superblock structure are summarized through the discussion of type, density, and pattern of street network and distribution, variety and intensity of functional activity of the selected Japanese superblocks. Integration, connection, and interaction are mainly discussed to understand the interrelationship between the two. Some comparisons between the two selected Japanese Superblocks from Kyoto and Osaka are also made in order to compare the Chinese Superblocks. Some basic design principles and advantages of the typical Japanese Superblock structure are also concluded at this stage and these affect the next stage of research design. This also answers the research question 2.

4.4.5.3. Comparing the Chinese and Japanese Superblocks

Thirdly, by using the findings from the above two discussions, the Supergrid and Superblock Structure in Chinese and Japanese cities can be compared and concluded in terms of the design principles, the similarities and differences, advantages, and disadvantages. These findings further lead to a proposal of an experimental 3D model that can be used to improve the structure of Chinese Superblocks in future development without compromising this cultural structure: the wall. This answers the research question 3.

4.4.6 Stage Six: Research Experimental Design

The final stage is to make experimental modifications of the two selected Chinese Superblocks, which have been discussed and analyzed through the method above.
The modifications use the design principles as concluded from the proposed model as discussed in stage five. The selected principles are made suitable for the Chinese context by developing and modifying Japanese principles within the setting of Chinese culture and circumstances. The experimental designs are included in the study only as an addendum, which provides further explanations of the findings of the study.

4.5. Limitation of this Method

Due to the complexity of urban study and the nature of cities, the method has some limitations that need to be noted.

The first limitation is the use of Space Syntax. It is an analysis that is very data sensitive. Small changes of the data input can affect the overall accuracy of the results. A number of limitations are already discussed by many existing studies: 1) the subjective and biased movement pattern measurements (Ratti 2004a, p.6; Marshall 2005, p.113); 2) not considering land uses (Batty et al, 1998, p.3); 3) oversimplification of the physical form cities, such as building height and different street types (Ratti 2004a, p.6); 4) uncertainties in the process of drawing axial maps, which would affect the results of space syntax (Batty 2001, Jiang and Claramunt, 2002), and discontinuous nature of axial map transformation and edge-effect of the axial map (Ratti 2004a, p.9-11); 4) it also does not directly differentiate the different modes of travel, and studies show that using integration value to predict the movement of vehicular traffic is more accurate than the prediction of pedestrian movement (Ratti 2004a). Because it is not affected by the metric distance or any topological logic, Space Syntax does not show how pedestrian decision-making formulates movements and it deals only with the ‘observed flows and thus only with aggregate statistical effects in different alignments in the grid’ (Hillier and Penn 2004, p.504). In other words, lines do not have brains to think, but humans do. Being aware of those limitations of this tool, this study tries to manage the data input by hand drawing to make sure that data input is as accurate as possible.
The second limitation of the method is the statistical information about the population and the flow of different modes of travel. Because of the lack of data for accurate population numbers and flows of people and cyclists, the population is estimated according to government data of broader statistical areas, and the collection of data on movement highly depends on the on-site accounting and observation by one researcher, which is not perfectly accurate. Because they are not the major focus of the study, this does not affect the result of this study, but it is still important to note this limitation.

Similarly, the third limitation of the data of functional activity could also contain some miscounting or omissions because of the complexity and difficulties in the process of data collection. For example, there could be an office that is on the ninth floor without any signs. The researcher could therefore have overlooked it and not included it in the mapping and data. However, the overall distribution of the different activities is as accurate as possible and the omitted activities are only minor so that this does not affect the general distribution of the structures. This does not compromise the general accuracy of the result, but still, it is important to point this out.
4.6. Summary

This chapter introduces the methodology of this study that is directly derived from the literature review as discussed in Chapters Two and Three. The philosophical and theoretical stance of this study is built upon an epistemology of understanding cities as an organized complexity that is composed of an urban web and semi-lattice structure with numerous interconnections between each element within the city. This also reflects the eastern ontology and epistemology of understanding, thinking and constructing cities as the study subject: the Supergrid and Superblock structure.

With such philosophical stance, the design of the research method of this study follows a strict, logical and rigorous process that includes six stages. Each stage is built on the previous one and provides further information for the investigation and conclusion in the next stage. By constructing a method framework that is built upon the Interconnection theory as discussed in Chapter Three, it clearly indicates three major aspects (Integration, Connection, and Interaction) of this study that are required in order to answer the research questions. This method framework also identifies clearly the data that is needed and how this data is collected as the second stage of the study; and how the collected data is converted into maps in stage three with clear rules and color-coding system. Stage four clearly identifies the aspects that need to be analyzed for the summary in stage five and the experimental design in stage six. These are important findings and applications of the findings that permit the drawing of further conclusions to this study.

This research study relies to a high degree on drawings and maps of the raw data that are collected from first and secondary sources and made through primary observation from on-site fieldworks. Although comparative case study is the major approach, morphological mapping is a fundamental tool that is applied to determine required data, to create maps and to analyze patterns that indicate the interconnections of the urban web that construct this Supergrid and Superblock structure. As the major way to understand and study the selected sites, the
mapping techniques are structured as a methodological framework derived from theory and moulded to fit into the study: it uses type, density, pattern distribution, variety and intensity as six measures to understand the general morphology of the structure, which is further used as base maps for creating maps for the analysis of Integration, Connection and Interaction of the structure. Moreover, the experimental design is another innovative approach that is not used much in traditional research studies. It is an important approach to assist this research, understanding the final conclusions and answering the central research question. By applying design principles of Chinese and Japanese superblocks in a provisional design process can the interrelationship between form and structure be well understood. Although some limitations do exist, they do not compromise the validity of the results and they are only minor and unavoidable. In other words, they also reflect the complexity of such urban studies.

End of Chapter Four
Chapter Five

Supergrid and Superblock Structure in China


5.1. Introduction

‘Walls, made of clay, stone or bamboo, low or high, have always contributed to the organization of city structure. They protect and define private sectors from the public domain, or even symbolize sacred places against the secular ones. They mediate, relate and enhance diversified elements in the city.’

Maki, Linkage Theory, p.59

Chapter Five discusses the Supergrid and Superblock Structure of Xi’an and Nanjing in China. The investigations are focused on two selected Superblocks: Jinyuan in Xi’an and Daguangli in Nanjing as sites for case studies.

The investigation of each selected Superblock includes three major parts. The first part discusses the findings of the Jinyuan Superblock in Xi’an as the first case study and the second part deliberates the results of Daguangli Superblock in Nanjing as the other case study. The comparisons and findings of the two Superblocks are discussed in the third part (Figure 5.0).

For each case study, it also includes three sections:

Each case study starts with an exploration of the historical transformation of the Supergrid and Superblock structure. It reflects the discussion of culture in Chapter Two and responds to the first sub-research question. The major message from this section is that the Superblocks in the two Chinese cities possess a pervasive use of the ‘wall and gate structure’ that is under the influence of Chinese culture.

The second section examines the general morphology of each selected Superblock through the investigation of the type, density, and pattern of the street network, and the distribution, variety, and intensity of activities. This section indicates how the street network is structured and how functions are distributed in each case study.
The third section assesses the Integration, Connection, and Interaction of the interrelationships between the street network and functional activity by using the method of mapping outlined in the Methodology chapter. This section reveals that the wall and gate structure rather than the street network is the major mediator of the distribution functional activity through its influence on movements.

The last section of each case study summarizes the key findings from the above three sections to reveal some interrelationships between the street network and functional activities in the selected Superblocks. It further concludes some commonly used design principles from the investigation of the two Superblocks under the Chinese cultural context.
Jinyuan, Xi'an

锦园，西安
Figure 5-1: Jinyuan Superblock in the Xi'an Supergrid - Global Scale
(Adapted from Google Map by Author)

- The CityWall
- The Study Site

Scale: 1:2.5 3.75km
5. X Supergrid and Superblock Structure in Xi’an

The city of Xi’an in its modern condition is about 3,866 km$^2$, including a highly urbanized inner city area of 540 km$^2$ (approx. 20X27 km) where the Supergrid is located (see Figure 5.X.1). The Supergrid has an average interval about 1km and creates Superblocks that are typically around 1km$^2$. The city is built on a relatively flat land, and the Supergrid is very regular and expands in all four directions. The natural landscape and numerous heritage sites both have a strong impact in places to distort the regularity and formality of the Supergrid. The Supergrid is supplemented by three major ring roads that provide intra-city connection and link to intercity fast traffic. Hence, they can take some long-distance traffic off the major arterial roads to extra levels, either as an elevated structure or underground tunnel.

The case study site is the second Superblock on the west side of the city wall as indicated in Figure 5.X.2. Jinyuan Superblock is about 0.75km$^2$ with average widths and lengths of 800m and 940m. The total built area is about 0.21km$^2$ giving a 26.3% building coverage (Figure 5.X.3). The population in this city is about 8.7 million, excluding migrant workers. The density of the study site is estimated between 243 to 300 people/ha – a figure calculated from information contained on an on-site poster that records population in the southeast quarter. The population of the area is very mixed, including local residents and migrant workers of different ages. Functionally, it is a local residential area for many Danwei (company or institutional compounds).
The Study Site

The Supergrid

Approx. 0.75 km²
5.X.1. Section One: Cultural Influence

5.X.1.1 The Cultural Influence on the Formation of the Jinyuan Superblock:

The evolution of the city over 2000 years has had a great impact on the formation of the modern Supergrid and Superblock structure. Figure 5.X.4 shows the Jinyuan Superblock in its modern condition as a 3D model. There are 401 individual buildings and the most common building type (about 80%) is the walled 6 to 8 story slabs in groups. Pavilions and one story row houses are mostly located on the edge of the Superblock or around the walled compound as part of the wall to enclose space.

Three important observations can be made of the model:

1) There is a pervasive use of wall and gate structure in this Superblock that reflects the wall-oriented spatial conception.

2) Individual buildings in different sizes are generally high, homogeneous and oriented to face south to get the maximum sunlight. They are also grouped collectively within walls and gates and stand in big open spaces as ‘Compositional Form’ (according to the categorization of built form by Maki 2008)

3) Edge buildings are generally of lower heights and with fewer walls than those of the inner area. Even though the lower edge is gradually replaced by higher towers, most of them still have a one to four level commercial podium at the bottom.
As an important spatial demarcation tool, the walls and gates as a system are also part of the built form as the buildings, the height of the walls can range from 1.8 to 3 meters.
5.X.1.2 The Formation of the Modern Supergrid and Areal Thinking

The earliest Supergrid and Superblock structure originates from the city of Xi’an in the Han Dynasty when the concept was still a prototype (see Figures 5.X.5.1 and 5.X.5.2). It was further developed to its full maturity as the famous Eastern planning model, which included a regular Supergrid with 108 walled Superblocks in the Sui and Tang Dynasties (see Figure 5.X.5.3). However, this structure was destroyed through numerous wars. When the city was reconstructed, it shrank to the size of what was previously the central Royal Palace area (about 3X4km), and this was from the Wudai to Ming Dynastic periods. While shifts in the location of gates in the city walls affected the positions of Global roads and the numbers and sizes of Superblocks in this period (see figure 5.X.5.4 to 5.X.5.8), it is the structure in the Qing Dynasty that inherited characteristics from previous dynasties to set the basis of the modern Supergrid. Modern expansion of the city starts from the two Global roads constructed in Qing Dynasty (see the dotted blue lines in Figure 5.X.5.1), and many Global roads and the drainage canal from the Tang period (see the blue line in figure 5.X.5.3) were also reused and rebuilt as part of the modern Supergrid system.

The Jinyuan Superblock has also been influenced by this transformation, because the position of the Global roads affects how the study site is connected to the other parts of the city. For instance, the heritage of the city in the Han Dynasty creates a major interruption in the modern Supergrid, especially on the West and East Global Roads of the Jinyuan Superblock. On the other hand, the North and South Global roads of Jinyuan Superblock were built as a continuation of the Global roads of the city in Qing dynasty (the horizontal blue dotted lines in Figure 5.X.5.1).

Despite the size of the city’s changes, the use of a Supergrid as a multi-directional structure is clearly constructed throughout the whole process of transformation. This reflects Eastern Areal thinking that sees space as multi-dimensional and multi-directional concepts.
FN: Superblocks were no later walled from Wudai to late Ming Dynasty, and all kinds of commercial activities were allowed to flourish everywhere in the city, but four Superblocks that were created by two Global roads were again walled in Qing Dynasty to separate people in different races (Man or Han).
5.X.1.3. Historical Transformation: The Wall-oriented Spatial Conception

Although there are strong influences on the positioning of the Global roads from early historical periods, as discussed above, Jinyuan Superblock was mostly formed through the expansion of Global roads from the 1950s to the early 2000s (see Figure 5.X.6). Four major stages of historical transformation of Jinyuan can be detected and are summarized in Figures from 5.X.6.1 to 5.X.6.5

The Liquan Superblock of the Tang Dynasty is the earliest predecessor of modern Jinyuan. Over 50% area of Jinyuan Superblock lies on top of the Liquan Superblock, as discovered in 1999 (Shaanxi Archaeology Institute 2008). As indicated in Figure 5.X.6.1, Liquan was a walled Superblock (838X1032m) next to the International Trade Market of the city. It accommodated about 10,000 people with a mix of temples, royal residences and pottery kilns (ibid. & He 2012). The gates were connected by two perpendicular 15m Glocal streets separating the Superblock into four smaller blocks. Four pairs of 5-6m Local cross streets further subdivided them into 16 street blocks, each containing a network of 2-3m Internal streets with walled courtyards in different sizes (ibid.). However, Liquan was destroyed and gradually occupied by several villages as part of a suburb of Chang’an (the name of Xi’an in the Tang Dynasty). Later, the area became a walled military training field during the Qing Dynasty, and it was further converted into a walled airport from the 1920s to 1991 (see Figures 5.X.6.2 & 5.X.6.3). Because of the noise issue, the airport was moved and gradually changed into a number of walled residential and industrial compounds (Figure 5.X.6.4). By 2002, the expansion of south Global roads finally completed the Superblock, and four Glocal roads (orange lines) were formed and continue to serve this Superblock (Editorial Board of the District of Lianhu of Xi’an 2001).

The historical transformation of the Supergrid and Superblock of this city indicates the importance of the wall and gate as a structural element that has been used consistently through the successive time periods. Resulting from the wall-oriented spatial conception discussed in Chapter Two, the street network is designed and constructed in relation to gates of the wall structure rather than the other way around, and this indicates a determinant role of the gate and wall structure in shaping the spatial order.
Figure 5.X.6.1 - Jinyuan Superblock - Historical Transformation
(Drawn by the researcher based on the Editorial board of the District of Lianhu of Xi'an 2001, & Zheng & Li 2007)

Figure 5.X.6.2 - Jinyuan Superblock - The Liquan Superblock in Tang Dynasty and Jinyuan Superblock in Red Dotted Lines
(Drawn by the researcher based on the description Shanxi Archaeology Institute 2008)

Figure 5.X.6.3 - Jinyuan Superblock - From 1920 to 30s and Jinyuan Superblock in Red Lines (Shi 1996)

Figure 5.X.6.4 - Jinyuan Superblock - From 1930s to 90s and Jinyuan Superblock in Red Lines
(Drawn by the researcher based on the Editorial board of the District of Lianhu of Xi'an 2001)

Figure 5.X.6.5 - Jinyuan Superblock - From 1990s to 2002 (Adapted from Planning Institute of Xi'an 2016)
Jinyuan Superblock is mainly subdivided into three sub-areas. Those areas are further subdivided by a maze-like wall structure, which is composed of walls, gates, and buildings (see Figure 5.X.7). The walls are generally one to three meters high, and the walled compounds are tightly located next to each other without any streets in between. The walls also create 46 smaller irregular areas, mostly are walled residential compounds. Figure 5.X.8 illustrates the basic block structure of Jinyuan, each area is about 0.47, 0.27 and 0.015 km² in size respectively. While the three sub-areas show no clear relationship to the wall structure, the locations of the gates in the wall structure determine a system of the private streets within each walled compound. In other words, the spatial order is mainly organized by the wall structure rather than the street network.
Figure 5.X.7 - Jinyuan Superblock - Wall and Gate Structure

- The Walled Areas
- Gates of Walled Compounds
- Global Roads
- Boundary Lines for Each Area

Figure 5.X.8 - Jinyuan Superblock - Block Sizes

- Red: 37,500 m²
- Orange: 30,130 m²
- Yellow: 15,400 m²
5. X.2.1 Investigation of the Street Network

5. X.2.1.1 Street Types

The four types of streets and the wall and gate structure are indicated in Figure 5.X.9, 5.X.10 and 5.X.11. They are structured to form a hierarchical network. The walls and gates are ‘converted’ to equate with the street types as explained in research method: Global, Glocal, Local, and Internal.

Four Global roads are all flanked with sidewalk streets that are directly connected to a string of stores (of four or fewer storeys in height) and the gates of walled residential compounds. They are mostly connected to Local gates to walled compounds than to streets. Road widths are about 50m and carry eight car lanes, and are crossed at only 8 points in total\(^1\). The sidewalks are mostly between 3 and 6m. One pedestrian bridge can be found on Global road on the East side, and a subway station will be constructed at the southeast intersection to provide a future underground crossing.

Four Glocal streets are related directly or indirectly to the study site (excluding four Global sidewalk streets). Two are in the study Superblock with 15m in widths and 3m sidewalks. The other two (indirect) are in the neighboring Superblocks and connect only to the Global sidewalk streets of Jinyuan. Most walls and gates are located along the Glocal streets, but shops are limited in certain segments of these streets.

Fifteen Local streets and 35 Local gates are linked directly to the Global roads. The streets are mostly short (the majority are under 50m), narrow (up to 4m wide) and directly connected to gated communities and open to Global roads at their ends. A few are very wide (20m to 30m), which makes them more like open spaces than streets. There are only three Internal streets but 25 Internal gates, and they are connected mostly to Glocal and a few to Local streets. Again, these Internal links are mostly related to the gates of walled compounds and cluster along the Glocal Street in the middle.

\(^1\) The north 750m of the west global road having four car lanes is only 25m.
Figure 5.X.9 - Jinyuan Superblock - Road/Street and Gate types

Figure 5.X.10 - Jinyuan Superblock - Road/Street Types in Sections
Figure 5.X.11.1- Global Roads

Figure 5.X.11.2- Glocal Streets

Figure 5.X.11- Jinyuan Superblock - The Four Street Types and the Wall Structure
Figure 5.X.11- Jinyuan Superblock - The Four Street Types and the Wall Structure

Figure 5.X.11.3- Local Streets

Figure 5.X.11.4 - Internal Streets
5. X.2.1.2 Street Densities (and Dimensions):

The average street length and width both indicates huge disparities of the four types of street and the hierarchical structure, as showed in Figure 5.X.10 and 5.X.12. The density of the four street types provides a quantitative understanding of the magnitude of the street network. The numbers of Global, Glocal, Local and Internal streets in proportion to the total number of streets are 0.13, 0.27, 0.5, and 0.1. At the same time, the numbers of Local streets (15) and gates (31) are also the highest, followed by Internal streets (3) and gates (23) that are connected to Internal streets and Glocal streets. This means that Global-Local type of connection is the strongest in the Superblock.

The total length of the street network is about 8km with a density of 10.67 km/km². The densities of Global, Glocal, Local and Internal streets are 4.64, 1.56 (6.2 including Global sidewalk streets), 1.9 and 0.4 km/km² respectively (see Figure 5.X.12). They indicate that the Global and Local connections have the highest street density, followed by Glocal and Internal streets. This again means that Global-Local type of connection is the strongest. However, the number and density of Glocal streets are very low, meaning that Jinyuan is not well connected to its neighboring Superblocks. This further indicates that both Local streets and gates are feeding traffic directly to the Global roads. It puts a lot of pressures on the Global roads because of the limited number and density of Glocal streets that cannot provide detours to relieve Global traffic routes. The limited number and density of Internal streets indicate a number of self-contained gated areas that provide very few paths to connect each other within the Superblock and the traffic is also transferred to the Global roads.
Figure 5.X.12 - Jinyuan Superblock - Key Dimensions of the Four Street Types

**Street Density**
- km/km²
- 4.64
- 6.2
- 1.56
- 1.9
- 0.4

**Number of Streets**
- 4
- 0
- 4
- 8
- 1
- 15
- 31
- 3
- 23

**Average Street Length**
- Unit: m
- 870
- 290
- 580
- 100
- 100

**Average Street Width**
- Unit: m
- 45
- 8.6
- 6.4
- 6.9
- 4.7

Key:
- Global Road
- Local Street
- Internal Street
- excl. Global Sidewalk St
- incl. Global Sidewalk St
5. X.2.1.2 Street Densities and Dimensions: Junction Analysis

The density of the street network can also be understood as the density of junctions. The gates of those walled areas are also part of the junction system as they are the exchange points between public street networks and private street networks. In general, the distribution of the junctions is far from even. They are mostly located along the four Global roads and around the Global-Glocal junctions (see Figure 5.X.13).

Table 5.X.1 indicates the numbers for all the publicly accessible junctions, including 9 intersections (4 Global-Global plus 5 Global-Glocal) and 61 T-sections (including gates) in a total of 70 junctions. The number of T-sections of streets is only 16, and the number of T-sections in a gate form is about 2.5 times as many as the T-sections of streets. Glocal-Glocal, Local-Internal and Internal-Internal type of street junctions does not exist in this Superblock. Local and Internal streets are not linked to any Internal streets except some Internal gates. Glocal and Local streets are only connected to streets but not gates.

These numbers imply a density of junctions at 93/km\(^2\) in general. The density of intersections and T-sections are 12/km\(^2\) and 81/km\(^2\) respectively. Including gates, the highest density of all junction types is the Global-Local T-sections with a density of 45/km\(^2\), which again reflects the Global-Local connection as the major type of connection for movement.
Figure 5.X.13 - Jinyuan Superblock Road/Street Junctions* – Distribution
(*including gates as cul-de-sac junctions)

Table 5.X.1 - Junctions Types and Numbers and Street Types of Jinyuan Superblock
(Note: 1. The counting does not include the Global sidewalk streets as part of the
Glocal street network; 2. The numbers include both streets and gates, and the
number of gates are listed in the table separately after the symbol G)

<table>
<thead>
<tr>
<th></th>
<th>Global</th>
<th>Glocal</th>
<th>Local</th>
<th>Internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>4/0</td>
<td>3/2</td>
<td>0/34 (G28)</td>
<td>-</td>
</tr>
<tr>
<td>Glocal</td>
<td>-</td>
<td>0/0</td>
<td>1/2 (0)</td>
<td>0/2 (G10)</td>
</tr>
<tr>
<td>Local</td>
<td>-</td>
<td>-</td>
<td>1/4 (0)</td>
<td>0/0 (G4)</td>
</tr>
<tr>
<td>Internal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0 (G5)</td>
</tr>
</tbody>
</table>

(G=Gates)
5. X.2.1.3 Street Patterns:

In fact, the general street network within the Superblock is mainly made up of cul-de-sacs within a Global grid. While all Global roads and Glocal streets are in a grid pattern, most Local streets and gates and all Internal streets and gates are in tree or cul-de-sac patterns. This makes for a well-connected grid at a Global scale, but does not create a well-connected street network at Glocal, Local and Internal scales. It is, using Alexander's terminology, a tree structure. And as indicated by Marshall, the tree or cul-de-sac patterns provide the lowest connectivity for facilitating the flow of movement. This means that the connectivity of the street network is higher at a global scale than it is at glocal, Superblock scales.

At Global level, the pattern of the Global roads is relatively even with an average interval of 0.91km between Supergrid roads. The pattern starts to deform as it encounters heritage areas and a major train line in the north. It also decreases and becomes less regular within the city wall area and around the second-ring road (where the bend is). The full length of each of the four Global roads is 15.5 and 21km (east-west), and 5 and 7km (north-south), which indicates that Jinyuan is better connected to other parts of the city in east-west direction than in north-south direction (see Figure 5.X.14.1). Currently, the city mostly relies on over 300 bus lines and two subway lines that mostly run along the Global roads for public transportation. It is planned to have 13 more subway lines forming a grid network beneath the existing Supergrid. This will create an extensive multi-level grid network for intra-city travels (Figure 5.X.15.1 & 2).

At Glocal scale, the patterns of streets are very different and these are largely of a tree pattern. Also, there is no connected pattern that extends to all neighboring Superblocks (see Figure 5.X.14.2). The network is sparse as a loose grid in the three Superblocks to the north of Jinyuan, and even sparser to non-existent in the three Superblocks on the south side. Connection in the Superblock to the East is only slightly better. Such pattern implies very uneven flows of traffic and movement and a poorly connected structure for medium-distance travel. The pattern and density of Glocal streets together indicate a tree network of limited connections to put pressure (extra traffic) onto Global roads for even medium distance travel.
At Superblock scale, the pattern of the network within Jinyuan is similar to that on a Glocal level: it is made of cul-de-sacs as a tree pattern. The small area in the north-east corner is the exception as a grid. While Global roads are in grid patterns and Glocal Streets less so, the majority of Local streets and all Internal streets are in cul-de-sac patterns. In fact, most streets in Jinyuan do not form a network, as they are mostly dead-ends as entrances to a number of walled areas (see Figure 5.X.14.3). This indicates an extremely low overall connectivity within Jinyuan, but a very strong connection between the inner areas to the Global roads. This again indicates that Global-Local connections are the strongest in a largely poorly connected cul-de-sac dominated pattern because of the prominence of the wall and the gate structure. With such a street pattern and more connections to Global roads, most movements are restricted between Global roads and Local streets by the wall structure, especially for automobiles (see Figure 5.X.15.3 and 5.X.15.4). Most Local roads and gates release movements directly onto Global roads and the general pattern of car movement is mostly along the four Global roads. There are also 20 bus lines that all run along the four Global roads. One subway line will later align along the east Global road with a station at the southeast intersection. As a result, all modal movements are found mostly along the Global roads.

It is necessary to refer to the many ‘private’ streets within each walled area. They are not recognized as being part of the city street network by Chinese planning regulations and are not publicly accessible (see Figure 5.X.14.4). Hence, they are not included in the street network of this study. These ‘private’ streets are also mostly in cul-de-sac or loop configurations as in a tree pattern, with trunk-like main streets connecting to gates and meandering paths extending as branches to each building within each walled compound. This is largely because within each walled area, there are often smaller walled compounds. The result is a hierarchical tree-structure connecting Glocal, Local, Internal and even private levels.
Figure 5.X.14.1 - Xi'an Supergrid and Jinyuan Superblock - Global Scale

Figure 5.X.14.2 - Jinyuan Superblock and Environs - Supergrid roads and Glocal Street pattern - Glocal scale
Figure 5.X.14.3 - Jinyuan Superblock - The Street Pattern - Local Superblock Scale

Figure 5.X.14.4 - Jinyuan Superblock - the Pattern of Streets within Gated Communities

Figure 5.X.14 - Xi’an Supergrid and Jinyuan Superblock - Street Pattern
Figure 5.X.15.1 - Xi'an Supergrid and Jinyuan Superblock - Subway Lines and Stations

Figure 5.X.15.2 - Xi'an Supergrid and Jinyuan Superblock - Bus lines and Stations

Figure 5.X.15 - Jinyuan Superblock and Environs - Supergrid roads and Movement
5. X.2.2 Investigation of Activity

5. X.2.2.1 Distribution of Activities

The distribution of four types of activities is indicated in Figure 5.X.16 (horizontal) and 5.X.17 (vertical, street sections), which include both the activities that take place in buildings, on streets and in public spaces. Consumption (628), production (84) and service (196) activities tend to gather in clusters or along the edges, and they are mostly separated from residential activities by the wall structure. While consumption and production activities generally share a similar distribution, production activities are a little more dispersed than the other. Residential components of the Superblock are found in walled areas with private streets connecting to each building. These have the most dispersed distribution and do not co-exist with production activities. This separation of residential activities may suggest longer travel times between living and working, buying and obtaining services. However, consumption, production, and service activities are mostly located in close proximity, which suggests mutual synergetic benefits from sharing customers. This indicates a norm of separating residential from other activities in modern Chinese planning, while the mixing of non-residential activities may partly compensate the impact of this separation.

Four key conditions can be deduced from Figure 5.X.18. 1) Activities tend to be mixed both horizontally and vertically, and they are clustered in particular areas and mostly separated from the residential activities. 2) Most consumption activities (86%) are distributed linearly along the Superblock edges with a few locating in the center of the south-east quarter. 3) In comparison, production activities are mostly found in four clusters, and service activities are the most dispersed; 4) Mixes of different types of activities are mostly distributed along the Superblock’s edges. Of all mixes, the mix of consumption and service activities is the most dispersed, and one that is often found vertically within buildings.
Figure 5.X.16 - Jinyuan Superblock - Distribution of Four Major Functional Uses/Activities

Figure 5.X.17 - Jinyuan Superblock - Street Sections with Activities on Different Levels
Figure 5.X.18 - Jinyuan Superblock - The Distribution of Different Functional Use/Activities
Figure 5.X.18 - Jinyuan Superblock - The Distribution of Different Functional Use/Activities
5. X.2.2.2 Variety of Activities

The mapping of the variety of activities shows wide ranges of building uses in the Jinyuan Superblock. Figures 5.X.19 and 5.X.20 indicate the uses in buildings and public spaces respectively. They indicate the diversity within each type of activity, which can satisfy the basic need of daily life in the study area. It also conforms Jacobs’ description of what a good neighborhood should be like. The highly diverse use of the space of Jinyuan can also be seen in the many clusters of street vendors forming morning and night markets (informal activities). Photos in Figure 5.X.20 shows some examples of those street activities, they are mostly in the consumption category, selling food and common household items.

Figure 5.X.21 shows the various building uses on different levels. There are three areas in which key observations can be drawn. 1) There is a wide variety of uses both horizontally and vertically, including 12% of the area of the Superblock for underground parking. 2) Building use at ground level is the most diverse and widely distributed compared to other levels. There is a sharp reduction of activities at the fourth level. Further, multi-level use of buildings tends to mostly occur along the Superblock edges (especially the east edge); 3) Informal street activities often complement the formal activities (within the buildings) creating an overall greater diversity in terms of functional use. Where there is more diversity within a building or group of buildings, more street activities can also be found. Greater formal and informal diversity are mutually benefiting and reinforcing a synergetic environment, but they also cause over-concentration in certain areas.
Figure 5.X.19.2 - Jinyuan Superblock - The Variety of Non-residential Uses in Buildings

Figure 5.X.20 - Jinyuan Superblock - Distribution of Uses in Streets
Figure 5.X.21 - Jinyuan Superblock - Distribution of Uses by Floor
Figure 5.X.21 - Jinyuan Superblock - Distribution of Uses by Floor
5.X.2.2.3 Intensity of Activities:

Intensity is measured according to the activity mix of the ground floor use of each building (horizontal) and the building uses on different floors (vertical). They are indicated in Figure 5.X.22 and 5.X.23 respectively. In general, the maps indicate a clear separation of the areas with high and low intensity.

Horizontally, the intensity of activity mixes is higher along the edges than in the middle. 51.8% of the area has only one type of activity (the lowest intensity). The area with the medium level of intensity takes about 24.4% (a mix of two types), which is still higher than the total area of both ‘High’ (17.8%, a mix of three types) and ‘Very High’ intensity (5.9%, a mix of four activity types). This indicates that most of the area of Jinyuan is for single use.

Similar to the horizontal mix, over 67% of the buildings have only one type of activity on the vertical level. Only 18% of the buildings contain the mix of two types of activities, and 15% have the mix of three and four types of activities. This again indicates a relatively low intensity of the functional mix on vertical level of Jinyuan in general.
Figure 5.X.22 - Jinyuan Superblock - Distribution of Mixed Functions - Horizontal

Figure 5.X.23 - Jinyuan Superblock - Distribution of Mixed Functions - Vertical

- **Very High** - Mix of Four Functions
- **High** - Mix of Three Functions
- **Moderate** - Mix of Two Functions
- **Low** - One Function
- **None**
5.X.3 Section Three: Interrelationships
Integration

Connection

Interaction
5.X.3.1 Integration

Space Syntax is used to understand the space-to-function relationships by analyzing the spatial configuration of the Xi’an Supergrid and Jinyuan Superblock at four levels: the whole city, the Supergrid (Global scale), the study site and its eight neighboring superblocks (Glocal scale), and the Superblock (Local scale): these are analysed in terms of their global integration (R=n) and/or local integration (R=3).

5.X.3.1.1 Analysis of the City Street Network of Xi’an

This analysis includes all the publicly accessible roads and streets within the area that is served by the Supergrid network and shows the intensity of movement and potential synergy. In general, both global and local integration maps indicate an even distribution of the movement and activity intensity across the city (see Figure 5.X.24.1 and 5.X.24.2), while the latter (R=3) shows more less-integrated street patches than the former (R=n). Despite the difference, the results still demonstrate a high level of integration across scales (Figure 5.X.24.3) without forming a strong ’deformed wheel’ or ’spiky potato’ configuration. It means that this urban structure can generate broad multi-directional movements and suggests a wide distribution of functional activities across the city.

Moreover, all the roads in red and most roads in orange were also the city axis that can be traced back to different dynasties as showed in Figure 5.X.5. They are consistently recognized as the more integrated streets in the city network through both global and local integration analysis. This again reflects the historical influence of the city structure.

Jinyuan Superblock is located in a more integrated part of the city showing well-integrated Global roads on all four sides in the two maps. The Global road on the north side is also one of the most integrated into the city network. However, the streets within the Superblock are not well integrated indicating a very low level of integration and low potential for activity intensity.
Figure 5.X.24 - Xi'an City Road and Street Network

- Figure 5.X.24.1 - Xi'an City Road and Street Network - Global Integration
- Figure 5.X.24.2 - Xi'an City Road and Street Network - Local Integration
- Figure 5.X.24.3 - Xi'an Scatter Plot - Showing a high level of Integration

**Spatial Accessibility/Connectivity**

- **Global Mean:** 1.82
- **Local Mean:** 2.40
- **Connectivity:** 4.69

**Level of Integration**

- Global Integration Value: $R_n$
- Local Integration Value: $R=3$

Global Mean: 1.82
Local Mean: 2.40
Connectivity: 4.69
5.X.3.1.2 Global Integration (the Supergid):

Space Syntax is also applied to analyze the level of integration of only the Global road network. Figure 5.X.25 show the analysis of the Global roads network of Xi’an through global integration (R=n). The result indicates that the general integration of the Supergird network in the central area is relatively higher. Two Global roads (in red) are not only the city axis, but also most the most integrated roads of the Supergird. In the east-west direction, the network becomes less integrated as it extends further away from the central (walled) area. However, in the north-south direction, the level of integration does not change much as it extends further away. Therefore, the integration of the Supergird does not show a ‘spiky-potato’ shape, but implies an even volume of traffic and activity intensity across the Supergird.

The selected Superblock is in a better-integrated part of the city with its four Global roads displaying relatively high (moderately high to very high) levels of integration. For global integration (R=n), the four roads surrounding Jinyuan Superblock show as red (on the south edge), orange (north), and yellow (east and west) with integration values of 1.88 (South), 1.78 (North), 1.64 (East) and 1.43 (West) respectively. This implies a high volume of movement around the four sides, particularly along the South Global roads.
Figure 5.X.25 - Xi’an supergrid - Global Integration Analysis
Space Syntax Map (Top)
and the integration value plot (bottom)
5.X.3.1.3 Glocal Integration (between Superblocks):

Figures 5.X.26.1 (R=n) and 5.X.26.2 (R=3) show analyses of the Global roads and Glocal streets in the area of nine Superblocks with the Jinyuan at the center. All Glocal streets within the study area show mostly green and blue in color in the global integration analysis, whereas in local integration analysis, these show mostly in yellow and in general are more integrated. In general, the result shows a moderate level of global-local integration (Figure 5.X.26.3).

The global integration analysis of Glocal street network indicates that the Glocal Street on the east (2.37) and North (2.2) have the highest global integration value (in red) among all the Glocal streets in the area of 9 Superblocks. This means that the two Glocal streets are the most integrated in this area and have higher movement and activity intensity than other roads.

The local integration analysis indicates that the Glocal street on the East (3.01), North (2.83) and West (2.80) sides of Jinyuan are well-integrated (in red) with the first, third and fourth highest integration value among all the Glocal streets. The Global road and its sidewalk street on the top (No.2 on Figure 5.X.26.2) has the second highest integration value of 2.85. This means that the three Global roads and their sidewalk streets around Jinyuan are more integrated into the street network at Glocal level, and they have potentially higher movement and activity intensities than other Glocal streets in the neighboring Superblocks.
Figure 5.X.26.1 - Jinyuan Superblock in Glocal Street Network - Global Integration

Figure 5.X.26.2 - Jinyuan Superblock in Glocal Street Network - Local Integration

Figure 5.X.26.3 - Global and local Integration Value - Scatter Plot

Figure 5.X.26 - Jinyuan Superblock - Street Network (Global and Glocal) Analysis at Glocal Scale

Global Mean: 1.14
Local Mean: 1.61
Connectivity: 3.04
5.X.3.1.4 Local Integration (within the Superblock):

The space syntax analysis of the street network in Jinyuan shows a low integration between local and global movements. Because of the wall and gate structure, the analysis includes two conditions: 1) accessible streets for both cars and people; and 2) accessible streets for people only.

Figure 5.X.27.1 shows the integration analysis of all the streets and gates by using local integration value (R=3). The result demonstrates that the Global roads are the most integrated into the street network within the study site. Among them, the South Global road on the south edge has the highest integration value of 3.14. The Global roads on the other sides also display high integration values, respectively 2.96, 2.93 and 2.9 on the north, West and East edges.

On the other hand, Figure 5.X.27.2 illustrates the integration analysis of all the accessible streets. Results show that the North Global road has the highest integration value (3.10) followed by the South (2.94), East (2.93) and West (2.72). One private street appears in red and has an integration value of 2.75. This was once part of a Glocal street, as discussed previously. All the other streets show in green and blue indicating poor integration (see Figure 5.X.27.2).

The two analyses reveal that whichever the measure, Global roads are the most integrated into the network within the Superblock and they are attached to higher activity and movement intensity than all other streets in Jinyuan. These also imply that most interfaces between local and global movements and between residents and visitors are highly fragmented and ineffective.
Figure 5.X.27.1 - Jinyuan Superblock Street Network - Local Integration

Figure 5.X.27.2 - Jinyuan Superblock - including privately streets with de facto access - Local Integration

Figure 5.X.27 - Jinyuan Superblock - Local Superblock Integration Analysis
5.X.3.2 Connection

5.X.3.2.1 Street Patterns and Activity Types

The connection between street pattern and activity types can be seen from Figure 5.X.28. Overall, the proportions of consumption, production and service activities that occur along the grid pattern are 79.3%, 97.6%, and 71.6% respectively. The proportion of each activity type that locates along the cul-de-sac pattern is 61.5%, 89.4%, and 67.3%. Residential activities are mostly related to the street network within each walled compound. A few non-residential activities can be found within gated areas, usually where Glocal streets previously existed. It shows similar distribution patterns of all non-residential activities and they indicate a slightly higher distribution along the grid than the tree/cul-de-sac pattern of streets. Of these, more consumption (56.7%), service (54%) and production activities (53.9%) are related to the cul-de-sacs in the form of gates rather than streets.

Two general findings can be concluded. 1) The Global and Glocal grid pattern is associated with more activities than the cul-de-sac pattern. The association of the grid pattern with higher connection clearly resonates with the general principle of Interconnection theory that higher connection attracts and generates more activities; 2) All three types of non-residential activity are found mostly along Global grid rather than the Glocal grid, and consumption activities have the highest percentage (74.4% and 52.0%) along both Global roads and Glocal streets.
Figure 5.X.28 - Jinyuan Superblock - Connection between Street Patterns and Distribution of Four Activity Types (Consumption, Production, Service and Residence)
5.X.3.2.2 Street Types and Activity Types:

The connections between street and activity types are indicated in Figure 5.K.29. Most non-residential activities gather along the Global roads, especially consumption activities (74.4%). Most consumption activities can also be found along Local connections, especially around the Local gates (68%). The residential activities mostly relate to private streets within walled area and they are not considered here. Street vendors and markets tend to gather along the Glocal streets and Global sidewalk streets.

Moreover, the distributions and densities of consumption, production and service activities on different street types are indicated in Figures 5.X.29 and 5.X.29.table. The numbers indicate four general distribution patterns. 1) The three types of activities can mostly be found along the Global roads, followed by Local gates and Local streets. This is because a lot of Local streets and gates are directly located on the Global roads. 2) The non-residential activities show different distributions. While consumption activities are mostly located along the Global roads, production activities have a stronger relationship to Local streets than other street types. Service activities are not strongly related to any street types1; 3) The street activities are mostly consumption activities that specifically gather along certain sections of the Glocal streets and the Global sidewalk streets; 4) more consumption and service activities can be found around Local and Internal gates of gated communities rather than Local streets.

![Figure 5.X.29. table - Street Types and Activity Density](image)

1 It is important to note that some activities can also be found within the gated area in the south-east quarter, this is because the streets were used to be glocal streets until 2010s as mentioned in cultural section above. If taking account of both previous and present Glocal Street, more service type can be found in relation to Glocal streets rather than local streets and gates.
Figure 5.X.29 - Jinyuan Superblock - Connection between Street Types and Distribution of Generic Functions (Consumption, Production, Service and Residence)
5.X.3.2.2 Street Types and Building Uses:
If more detailed observation is made, particular building uses can be found to relate to specific street types as indicated in Figure 5.X.30.

1) 91% (114/125) of restaurants are located along the Global Roads and Glocal streets, and 58% (73/125) are around gates.

2) 79% (144/182) of stores are located along the Global and Glocal streets. 67% (123/182) are located around gates.

3) 70% of convenience stores and Supermarkets are close to gates, where they can capture the flow to the gated communities.

4) All entertainment uses (like KTV, clubs, and baths) are located along Global roads and 95% (19/20) are located in close proximity to gates. 57% (8/14) of the car related shops are located along Global roads, and 78.6% are located along global and present Glocal streets. All activities are related to Global and Glocal streets, if both previous ‘Glocals’ are included.

5) 94% (16/17) of offices and 75% of the factories are located along Global roads. As with schools, all factories are located along Global or Glocal streets if previous Glocal streets are included.

6) While hospitals show no clear relationship to any street type, 86% of schools are located along the Global roads or Glocal streets. In fact, all schools gather along Global and Glocal streets if the previous Glocal streets are taken into account.

7) 80% of the banks are along the Global roads.

8) 80% of the hotels concentrate on Global roads and Glocal streets excluding the previous Glocal streets, and all hotels are located along global roads by taking the previous Glocal streets into account.
Figure 5.X.30 - Jinyuan Superblock - Connection between Street Types and Building Use
5.X.3.2.4 Street Densities and Activity Types:

The relationships between street junctions and distribution of activities are indicated in Figure 5.X.31. It shows a strong correlation between all non-residential activities and T-section, and about 67% of the non-residential activities are associated with T-sections in the form of gated cul-de-sacs. Of these, 61% are related to Global-Local T-sections (Local gates) and 27% are related to Glocal-Internal T-sections (Internal gates). This is again largely because of the wall structure that creates more gates forming T-sections rather than intersections. Production activities only show about 40% correlation to junctions. In comparison, consumption and service activities are more related to Global-Local T-sections in the form of gates than production type. Residential activities are related predominately to the private street systems inside of the walled compounds.

Other important points in influencing distribution patterns are the Global-Glocal junctions. They are associated with many activities that are in buildings and on streets (and both). Three major Global-Glocal junctions (one intersection and two T-sections) are associated with a lot of street vendors. They are mostly consumption activities (see the green circles in Figure 5.X.31). This indicates a clear correlation between consumption activities and Global-Glocal junctions. When no physical building is available for activities to take place, street markets are formed to supplement the ‘missing’ physical structure to capture the benefit of the ‘movement economy’.
Figure 5.X.31 - Jinyuan Superblock - Connection between Street Junctions and Generic Functions
5.X.3.3 Interaction

5.X.3.3.1 Street Types and Activity Mix:

The relationships between street type and the activity mix in buildings are indicated in Figure 5.X.32. In general, most (92%) non-residential activity mixes are located along the Global roads and Glocal streets. The strongest relationship here is the 72.5% of consumption and service mixes (in purple) that occurs along Global roads. In comparison, 57% of consumption and production mixes (in orange), 75% of service and production mixes (in green) and 67% of the mix of three types also concentrate along the Global roads. This shows a relatively weaker relationship between the mix of production and consumption activities and Global roads than other types of activity mix.

On the other hand, the percentage of mix of consumption and service activities locating around gates is 79%. It is even higher if the street activities are also taken into account. However, no mix of consumption and production activities and only 25% of the mix of production and service type can be found around gates.
Figure 5.X.32 - Interaction between Street Network and Functional Mix

- **Consumption + Service Mix**
  - Total: 30
  - Global: 22
  - Local: 12
  - Glocal: 6
  - Internal: 2

- **Consumption + Production Mix**
  - Total: 7
  - Global: 4
  - Local: 3
  - Glocal: 0
  - Internal: 0
  - Private: 2

- **Production + Service Mix**
  - Total: 4
  - Global: 3
  - Local: 2
  - Glocal: 0
  - Internal: 0

- **Mix of Three Types**
  - Total: 3
  - Global: 2
  - Local Gate: 1
  - Internal: 0
  - Glocal: 0

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C5-59
5.X.3.3.2 Street Types and Building Use Mix:

More specifically, the mix of activities in relation to different street types can reveal how interactions between the two work. While many do not show clear any correlations, the following three pairs of maps indicate some relationships (see Figure 5.X.33).

The first pair of maps indicates the distribution of all restaurants from consumption type and hotels from service type of activity in relation to the street network. This shows where people stay and where they eat. The mix of hotels and restaurants can only be found along Global roads or Local streets rather than around gates, and over 75% of these are found in the northeast section.

The second pair of maps indicates the distribution of offices or companies from the production type, banks from the service type and convenient stores from the consumption type. This shows how people work, shop and manage their finance. The result indicates a strong interaction between Glocal streets and the mix of the three functions (two are along present Glocal and one is along the previous Glocal Streets).

The third pair of maps shows the distribution of offices and factories from production type, restaurants from consumption type and hospitals/clinics from service type. These show where people work, buy food and visit a doctor. The mix of the three shows four areas of concentration of the mix of the three uses together and they relate only to Global roads and Glocal streets (the area in the green circle relates to the two streets that were previously Glocal but recently changed).
Figure 5.X.33 - Interaction between Street Network and Building Uses
5.X.3.3.3 Street Densities (Junctions) and Activity Mix:

The relationships between types of functional activities and street junctions are indicated in Figure 5.X.34. The maps indicate clearly that mixes of activity types happen mostly around the Global-Local T-sections (about 86%), which are the Local gates. In comparison, Global-Global intersections do not show a strong relationship to activity mix in this Superblock.

Mixes of consumption and service activities are mostly located around Local T-sections. Of these, most (about 60%) are located around the Global-Local T-section. Only 10% of the intersections correlate to the mix of consumption and service activities. Production-service activity mix or consumption-production activity mix show no clear relationship to any particular type of street junctions because of their limited number.
Figure 5.X.34 - Interaction between Street Junctions and Functional Mix

Consumption + Service Mix

- Intersection: 3
  - Global-Global: 2
  - Local-Local: 1
- Total: 30

Production + Service Mix

- Intersection: 0
- Total: 4

Consumption + Production Mix

- Intersection: 1
  - Global-Local: 1
- Total: 7

Mix of Three Types

- Intersection: 0
- T-section: 2
  - Global-Local: 1
  - Local-Local: 1
- Total: 3

- T-section: 1
  - Global-Local T-section: 1
  - Private (Previous Glocal-GLocal): 1
- Total: 3
5.X.3.3.4 Street Types and Activity Mix Intensities:

The co-functioning of activities on the horizontal level shows a clear pattern of separation between high and low intensity areas across the Superblock (see Figure 5.X.35.1). The ‘High’ and ‘Very High’ intensity areas (in dark pink and red) show a stronger relationship to Global roads (79%) than any other street types. 'High' intensity also has a clear relationship to Global-Local T-sections, followed by Global-Glocal junctions.

In comparison, the activity mix on the vertical level also shows a clear separation of the areas with high and low intensity (Figure 5.X.35.2). The small grid area in the northeast corner of the site (where there is a mix of streets and gates) shows the highest intensity. This echoes the theoretical position that more functional mix tends to occur in areas of the greatest structural mix. The intensity is also higher along the Global roads and Glocal streets than other street types. Further, the higher intensity of mixed activities can be seen to bear a clear relationship with Glocal-Local T-sections (mostly in the form of gates) and Global-Glocal junctions.
5.X.35.1 The Mapping of the Intensity on Horizontal Level

Different Street Types

Different Street Junctions

5.X.35.2 The Mapping of the Intensity on Vertical Level

Different Street Types

Different Street Junctions

Figure 5.X.35 - Jinyuan Superblock - Interaction between Street Network and Function Mix Intensity
5.X.4 Section Four: Discussion of Findings

The analysis of Jinyuan Superblock reveals a number of important findings. The most important message is that culture plays an important role in shaping and forming a distinctive morphology over the study site through the dominance of the ‘wall and gate’ structure.

In the examination of the Superblock’s physical configuration, the analysis of type, density, and pattern of the street network indicates very strong Global-Local connections. These two street types also have a higher density than other two types, which is mainly because the pervasive use of walls and gates to reorganize the street network with restricted connections. Although Global and Glocal streets are formatted as a sparse grid pattern, Local and Internal streets are mostly in a tree/cul-de-sac pattern connecting to networks of private streets within the walled compounds. It creates more Global-Local T-sections in the form of gates rather than intersections. Such a street network directs most movement to the Global roads through the many Local streets and gates.

The investigation of functions (distribution, variety, and intensity of activities) reveals a clear separation of residential and non-residential activities by the wall and gate structure. All non-residential activities tend to gather together and create highly mixed-used clusters over limited areas. Such a distribution creates highly intensified areas of mixed activities around the edges of the Superblock with broad less intensified areas in the middle. Moreover, this site has a large number of street vendors forming morning and night markets in places where they can supplement the fixed service activities (such as at the front gates of hospitals and schools). This further intensifies mixed functions in particular places in the Jinyuan superblock.

The Integration analysis of the Jinyuan shows that the Superblock is located in a more integrated part of the Supergrid, and the Global roads on the North edge of Jinyuan are one of the most integrated roads in the whole city network at the Global scale. The Global roads on the eastern and northern edges of Jinyuan are also the most integrated at Glocal scale. The four Global roads are still well integrated with the one on the south edge having the highest integration value at local/Superblock scale. This set of analysis clearly indicates that the four
Global roads are well integrated across all scales, and thus they are the places where most traffic flows and hence a higher level of activity intensity is expected and does occur.

The analysis of Connection indicates a strong relationship between Global roads and all non-residential activities, especially consumption activities. This is consistent with the space syntax analysis, especially at the Superblock scale. It also shows that the gates of the walled areas that form the Global-Local connections are mostly associated with consumption and service activities. Local streets and gates feed movement directly to the Global roads because the gates acting as thresholds to collect and diffuse movement of different modes. This attracts more activities to serve the flow and encourages more movement and activities to concentrate along the Global roads. While all types are affected by this street-movement-activity principle as discussed in the Theory chapter, consumption activities can be found having the strongest relationship to the gates than all other street and activity types.

The analysis of Interaction illustrates that the mixes of activities are also mainly related to Global roads and Global-Local T-sections, and the interaction between the Global roads, Local gates and the mix of consumption and service activities is the strongest. Although the mix of consumption and production, and the mix of production and service activities also follow the same rule of distribution, their limited numbers mean that the co-functioning of the two types is unusual in the Jinyuan Superblock. Furthermore, the activity mixes on both horizontal and vertical level show a clear separation of high and low intensity, and they also tend to concentrate along the Global roads, around the gates, and in the northeast corner. It implies that the gates controlling movements, the grid pattern with a higher connectivity (Marshall 2005) and more mix of street types (Jacobs 1961) can attract more mix of activities.
Daguangli, Nanjing
大光里，南京
Figure 5.1 - Daguangli Superblock in the Nanjing Supergrid - Global Scale
(Adapted from Google Map by Author)

The Study Site
The Supergrid
5.N Supergrid and Superblock Structure in Nanjing:

The city of Nanjing sustains 8.23 million people (excluding all the migrant workers) over 924km$^2$ of land. The highly urbanized inner city area is about 180km$^2$ (15X12km), which is mostly covered by a Supergrid and Superblock structure as indicated in Figure 5.N.1. The geographical features and numerous heritage sites also contribute to an irregular spatial canvas for the structure. The Supergrid has a generally more regular grid pattern with an interval at about 1km within the old city wall area, beyond which it starts to show deformations in the north part and where it is close to water elements and mountains. It also has a more regular but smaller grid interval (0.5-1km$^2$) in the riverside area, which is a recently built district, mostly in the 21st century.

The case study site, Daguangli Superblock, is located on the edge of the Supergrid (see Figure 5.N.2). The neighboring Superblocks on the south, east and north sides are slightly deformed and fragmented because of the natural landscape and certain Global roads are still under construction. The selected Superblock is relatively the more regular one even though it is cut by a water channel. Being close to the ring road and the city wall gives the site slightly greater locational importance in the Supergrid.

The size of the Daguangli Superblock is about 1.4 km wide and 0.8 km from north to south, giving an area of about 1.2km$^2$ (Figure 5.N.3). The total built area is about 0.34 km$^2$ (28 % building coverage), with a population density of approximately 210 people/ha (estimation based on Editorial Board of local Chronicles of the City of Nanjing, 2008 & 2009). The population of this area is mixed with people of different ages and including local residents and migrant workers. It is mainly a residential area without industrial uses.
The selected Superblock at Glocal Scale
(Adapted from Google Map by Author)

The First Ring Road
The City Wall

The selected Superblock: Daguangli Superblock at Local Scale
(Adapted from Google Map by Author)

Approx. 1.2 km²
5.N.1 Section One: Cultural Influence

5.N.1.1 The Cultural Influence on the Formation of the Daguangli Superblock

The general built form of Daguangli Superblock illustrates a number of buildings that are grouped into many compounds (often larger than street blocks) and mostly surrounded by walls (see Figure 5.N.4). The major building type is the walled 6 to 8 story slab buildings in groups, which takes more than 56% of the Superblock. They are often mixed with some individual high-rise towers, one to two story pavilion, slab buildings and courtyard buildings, which are also in groups. The smaller pavilions and courtyard building groups also have a village-like small grain size in form. Of these, one is a historically protected area and the others are currently used as slums. Buildings with larger footprints occur in the southwest section, while other parts tend to have a mix of buildings types and footprints: these also have a greater range of ages and functions. A water channel that once surrounded the Royal Palace in Ming now runs through the Daguangli Superblock in a, more or less, east-west alignment. It separates the Superblock into north and south halves with only two bridges to connect.

This Superblock demonstrates three major characteristics:

1) There is a pervasive use of the wall structure, which is not disrupted by the waterway (see red lines in the Figure);

2) The built form is mostly composed of walled tall buildings standing in extensive open spaces mixed with a few groups of smaller buildings;

3) The built form is generally lower around the edges and higher in the middle of the Superblock, although some taller buildings can also be found at the edges.
Figure 5.N.4. - Daguangli Superblock - 3D Model (Top) and Built Form (Bottom)

- The Wall Structure
- The heritage area
- newly built tower-slab type of building in groups within walls
- two walled compounds are being demolished
- a slum

- Building
- Gates
- Wall
- Walled Area

Figure 5.N.4. - Daguangli Superblock - 3D Model (Top) and Built Form (Bottom)
5.N.1.2 The Formation of the Modern Supergrid and Areal Thinking

The modern Supergrid of Nanjing has been formed under the influence of three major ancient cities that were built in this area. The imprints of the city structures of the Six Dynasties (229-529), Southern Tang Dynasty (937-975), and Ming Dynasty (1368-1644) remain clear on the modern Supergrid (see Figure 5.N.5.1). Those capital cities were also constructed with Supergrid and Superblock structures in which many major roads were related to city gates in city walls. In other words, major roads between the gates of those ancient capitals were used as city-wide or ‘global’ connections (indicated as dotted green, purple and orange lines), and these roads divided the cities into Superblocks. Those Global roads of ancient time set an embryonic framework for the Capital Plan in 1929.

It is of particular interest that the Capital Plan was directed by two American planners, who were trying to transform Nanjing into an ‘Eastern Washington’ by adopting what was considered to be the most advanced modernist planning at the time (Editorial board of local chronicles of the city of Nanjing, 2008 & 2009). The city was designed with some radial roads and a small grid structure as was commonly used in Western cities (see Figure 5.N.5.2 in both black and red lines). The grid is particularly small in the northwest and the east part of the city, where little historical development had occurred. However, the small grid network was never fully realized because of the triangular shape land parcels that are generated by a radial-grid structure and were considered as a waste of land in the Chinese spatial conception (ibid, p.20 & Wang 2014). As a consequence, the modern plan was adapted from this Capital plan by Chinese planners, and they formulated the idea of using squares to expand concentrically in all directions (ibid.), which by its nature is a Supergrid and Superblock structure. (See red lines and lighter red lines in Figure 5.N.5.2) Because of differences in the understanding of space between cultures, the formation of the Supergrid in Nanjing (with components from Radial and small grid and Areal Supergrid thinking) illustrates well the differences between Eastern Areal and Western Linear conception of space, as discussed in Chapter Two.
Figure 5.N.5.1 - The Historical Transformation of the Supergrid in Different Period of Time
(Drawn by the researcher based on the records from Wu 2011, Yang 2009, Editorial Board of local Chronicles of the City of Nanjing, 2008 & 2009, Chen & Gazzola 2013, Zhu 2014)

Figure 5.N.5.2 - The Comparison between the Capital Plan 1929 and Modern Supergrid Network
(Drawn by the researcher based on the records from the Editorial Board of local Chronicles of the City of Nanjing, 2008 & 2009, Zhu 2014)

Figure 5.N.5. - Daguangli Superblock - The Historical Transformation of the Supergrid
5.N.1.3 Historical Transformation and the Floor-oriented Spatial Conception:

Daguangli Superblock has been formed since the 1960s, and it is still under construction during the time of this research (see Figure 5.N.6.1). Several historical Global connections that can be traced back to South Tang Dynasty were extended to this area in Ming Dynasty. They provided links to other gates and formed a basic traffic skeleton for this area. Because of the proximity to the royal palace on the north side of the Superblock, this area was built with various government compounds and the residences for government officials at the time. Later in Qing Dynasty, it retained the same structure but with more subdivisions and the built area was expanded to the two sides of the diagonal street, which linked two city gates (see Figure 5.N.6.2). Between the 1920s and 50s, the area went through even more subdivision in the southeast half, and the area on the north side of the water channel was used as a military airport. During this period, the shape of the Superblock was gradually formed with Global connections on three sides (see Figure 5.N.6.3). The resulting structure within the Superblock was not changed dramatically until the 1960s when many of the irregular streets were removed and the water channel and diagonal street were modified with more regularity (see Figure 5.N.6.4). More importantly, the area was fully enclosed by four Global roads: two were extended and two remained narrow until the 1990s as indicated in Figure 5.N.6.1. Some new gated communities were built in this period but were not walled at first: an extensive wall structure emerged as more housing for communities was constructed in this area.

This clearly indicates strong historical continuity of the road and street network that has arisen from Areal thinking and a wall oriented spatial structure. The Global roads of the Daguangli Superblock were historically connected to the city gates as global connections, and the wall and gate structure is still dominating the Superblock and exercising its power of controlling movement at a different scale. The processes of transformation of this Supergrid and Superblock structure indicate the wall and gate structure as a strong structural determinant in the making of this city at multiple scales and through time.
Figure 5.N.6 - The Historical Transformation of the Supergrid in Different Period of Time
Figure 5.N.6.1 - The basic Morphology of Daguangli Superblock in Ming Dynasty
Figure 5.N.6.2 - The basic Morphology of Daguangli Superblock in Qing Dynasty
Figure 5.N.6.3 - The basic Morphology of Daguangli Superblock from 1920s to 1950s
Figure 5.N.6.4 - The Basic Morphology of Daguangli Superblock from 1960s to 1980s

5.N.2 Section Two: General Morphology

The walls and gates together form a dominant structure in this Superblock. They are mostly confined within the 14 street blocks and align consistently with the edges (see Figure 5.N.7). Each street block also contains a number of gated communities that vary greatly in size: some communities are almost as big as the street blocks with no streets going through and some are just of the size of a courtyard. The street blocks also have a wide range of size between $0.012\text{km}^2$ and $0.23\text{km}^2$ with an average of $0.086\text{km}^2$. The three smaller ones are close to the size of western street blocks, while the bigger ones are more common in Chinese cities (see Figure 5.N.8). The street blocks are also smaller in the area to the south of the river channel than the north part creating a more permeable structure in the south.
Figure 5.N.7 - The Wall and Gate Structure of the Daguangli Superblock

Figure 5.N.8 - The Blocks Sizes and Pattern of Daguangli Superblock

- Yellow: 11,700-17,010m²
- Orange: 63,940-105,000m²
- Light Orange: 49,450-67,500 m²
- Red: > 228,825m²

Global Roads
River Channel
The Walled Area
5.N.2.1 Investigation of the Street Network:

5.N.2.1.1 Street Types

Figure 5.N.9 shows the street network and the wall and gate structure of Daguangli Superblock. There are two major types of connection: Global-Local and Glocal-Internal, which largely determine the flow of traffic.

The four Global roads are all flanked by sidewalk streets on both sides, and mainly connected to Local streets and gates. Their widths range from 35m to 50m with four to eight carriageways, two strips of trees and bike paths (see Figure 5.N.10). Aligned with the road on the western edge is an underground tunnel that is part of the first ring road. The road on the east edge will be widened to 50m from current 40m with the construction of a new subway line. Two major subway stations will be built on the South and East Global road.

12 Glocal streets (excluding 4 global sidewalk streets) can be found evenly distributed in this Superblock. Among them, seven are very short and do not run very far into neighboring Superblocks: their widths range from 3m to 23m and they are mostly connected to a large number of Internal gates. Six (No.1, 2, 3, 4, 5, 7, 11 in Figure 5.N.11.2) are also flanked by sidewalks and shops on both sides, while the rest are flanked by walls. Part of two Glocal streets (No.2 and No. 12 indicated as dotted black lines in Figure 5.N.11.2) are associated local markets. One is a covered street market and the other is a 5m narrow street leading to a market within a building. They are only accessible by pedestrians and bikes.

The Local street network includes 11 streets and 19 gates, and they are all less than 10m wide. While most Local streets are connected to the south Global road, Local gates are mostly concentrated along the north Global road. Similarly, more Internal gates (97) than streets (16) can be found in this Superblock with the widths ranging from 1.5 to 10m. Internal gates are mostly located along Glocal streets, and Internal streets (only 6) are usually shared space.
Figure 5.N.9 - Daguangli Superblock - Street Network and Wall Structure

Figure 5.N.10 - Daguangli Superblock - Road/Street Types in Sections
Figure 5.N.11- Daguangli Superblock - The Four Types of Streets and Wall Structure
Figure 5.N.11.3 - Local Streets

Figure 5.N.11.4 - Internal Streets

Figure 5.N.11 - Daguangli Superblock - The Four Types of Streets and Wall Structure
5. N. 2. 1. 2 Street Densities (and Dimensions):

Some key dimensions about each street type is indicated in Figure 5. N. 12. The proportions of Global, Glocal, Local and Internal streets in the total number of streets are 0.1, 0.34, 0.21 and 0.34. The proportions change dramatically to 0.01, 0.09, 0.2 and 0.7 respectively if all Local and Internal cul-de-sacs (gates) are included.

The density of each street type indicates that the Glocal streets (5.01 km/km²) have the highest density among all types, followed by Global roads (3.7 km/km²), Internal (1.75 km/km²) and Local (1.4 km/km²) streets. Internal connections (both streets and gates) are the most numerous. Together they make the Glocal-Internal type of connection, which becomes the most extensive network in the Daguangli Superblock and it is the most frequently used for movement. In other words, this Superblock is well connected to the other neighboring Superblocks through Glocal streets with many Internal streets feeding people to them. In comparison, Global streets with a lower density are connected with much fewer local streets and gates. This means that the Global-local type of connection becomes a supplement to the Glocal-Internal type.

Although the density and number indicate that the Glocal streets form the most extensive network, their average length is less than half of the Global roads. This implies that Glocal streets do not go very far into the neighboring Superblocks. The average width, on the other hand, indicates that a huge disparity between street types. The width of Glocal sidewalk streets is very close to the width of Glocal streets reinforce that they are part of the same network as claimed by Shelton.
Figure 5.N.12 - Daguangli Superblock - Key Dimensions of the Four Street Types

**Street Density**
Unit: km/km²

<table>
<thead>
<tr>
<th>Street Type</th>
<th>Global Sidewalk St</th>
<th>Global Sidewalk St</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street Density</td>
<td>excl.</td>
<td>incl.</td>
</tr>
<tr>
<td>Global Road</td>
<td>1100</td>
<td>19</td>
</tr>
<tr>
<td>Glocal Street</td>
<td>420</td>
<td>19</td>
</tr>
<tr>
<td>Local Street</td>
<td>550</td>
<td>11</td>
</tr>
<tr>
<td>Internal Street</td>
<td>150</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3.7</td>
<td>4</td>
</tr>
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**Number of Streets/Gates**

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</tr>
</thead>
<tbody>
<tr>
<td>Street Gate</td>
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<td>4</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>98</td>
<td>16</td>
</tr>
</tbody>
</table>

**Average Street Length**
Unit: m

<table>
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<th>Street Type</th>
<th>excl. Global Sidewalk St</th>
<th>incl. Global Sidewalk St</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Street</td>
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<td></td>
</tr>
<tr>
<td>Density</td>
<td>8.75</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>5.01</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>3.7</td>
<td></td>
</tr>
</tbody>
</table>

**Average Street Width**
Unit: m

<table>
<thead>
<tr>
<th>Street Type</th>
<th>excl. Global Sidewalk St</th>
<th>incl. Global Sidewalk St</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Width</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>4.25</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>11.1</td>
<td>4.5</td>
</tr>
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<td></td>
<td>6.6</td>
<td></td>
</tr>
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</table>
5.N.2.1.2 Street Densities (and Dimensions): Junction Analysis

Figure 5.N.13 indicates the number of junctions of all publicly accessible streets and cul-de-sacs, including 21 intersections and 178 T-sections in a total of 199 junctions. However, the distribution of the junctions is not even. While the intersections are distributed across the site, most are found along the four Global roads. In comparison, T-sections joining streets, or as Local and Internal gates are distributed mostly along Glocal streets.

16 types of junctions can be further examined as indicated in Table 5.N.2. The percentage of all T-sections in the total of junctions is 89 % (178/199). Of these, 16% (29/178) are Local gate T-sections, 56% (99/178) are Internal gate T-sections. It indicates that the highest proportion of all junction types is the Glocal-Internal T-sections (58%, 115/199) that are formed by both streets and gates. The Global-Local T-sections that are formed by both streets and gates ranks the second with 15% (29/199). Among all types of intersection, Global-Glocal intersections (13/21, 62%) take the highest percentage.

These numbers elucidate again that Glocal-Internal streets type connection is the dominant type, especially with a very high number of T-section in the form of gates. It clearly indicates the importance of Glocal streets in the Superblock.
Figure 5.N.13 - Daguangli Superblock Road/Street Junctions* – Distribution
(*including gates as cul-de-sac junctions)

Table 5.N.2 - Junctions Types and Numbers and Street Types of Daguangli Superblock
(Note: 1. The counting does not include the Global sidewalk streets as part of the Glocal street network; 2. The numbers include both streets and gates, and the number of gates are listed in the table separately after the symbol G)

<table>
<thead>
<tr>
<th></th>
<th>Global</th>
<th>Glocal</th>
<th>Local</th>
<th>Internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>4/0</td>
<td>13/0</td>
<td>0/29 (G18)</td>
<td>-</td>
</tr>
<tr>
<td>Glocal</td>
<td>-</td>
<td>3/2</td>
<td>0/4 (0)</td>
<td>1/115 (G99)</td>
</tr>
<tr>
<td>Local</td>
<td>-</td>
<td>-</td>
<td>0/0</td>
<td>0/22 (G10)</td>
</tr>
<tr>
<td>Internal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0/6 (G5)</td>
</tr>
</tbody>
</table>

G=Gates
5.N.3.2.3 Street Pattern:

The pattern of the street network is a grid mixed with cul-de-sacs. In Alexander’s terminology, this Superblock has a mix of a ‘semi-lattice’ and ‘tree’ that is formed by different street types to provide various levels of connection. Following Marshall’s work on Street Patterns (Marshall 2005), it is also reasonable to conclude that while this Superblock is well-connected to the Supergrid through four Global roads, the Glocal, Local and Internal streets network show a decreasing connectivity moving from Global to Superblock scale.

At Global scale, the road network is in a grid pattern with a typical interval of 1km, although the grid pattern gets smaller and more irregular within the inner city area. It also becomes smaller and regular along the riverside on the west and larger in the east and north area of the city (see Figure 5.N.14.1). The grid pattern tends to deform when it encounters rivers, mountains, and some historical sites. The lengths of the north, east, south west Global roads surrounding Daguangli are 6.8, 13.7, 9.5 and 12.9km. This indicates longer uninterrupted connections in the North-South than East-West components of the network. While the city is still under construction, the grid pattern to the East side of the Daguangli Superblock is incomplete and irregular. With such Supergrid, most bus lines and all subway lines are running along the Global roads providing a very extensive network of public transportation in multiple directions (see Figure 5.N.15.1 and 5.N.15.2).

At Glocal scale, the pattern of the street network is very fragmented with few good connections (see Figure 5.N.14.2). In the area of Daguangli and the Superblocks immediately about it, there is a mix of grid and cul-de-sac patterns. Glocal streets in the study sites are numerous forming a network, but they do not extend far beyond. The three Superblocks to the west generally enjoys good connection but they are not connected to the study site. The strongest Glocal connection is north-south where one street traverses fully three blocks but otherwise Glocal connections are short and few. This creates an uneven distribution of the grid and tree/cul-de-sac pattern of street network, but Daguangli Superblock is actually the most well-connected in the area of nine Superblocks.
At the Superblock scale, Daguangli contains a street pattern that is a mix of grid and cul-de-sacs (see Figure 5.N.14.3). While all Global roads and the four longest Glocal streets form a grid pattern as a skeleton, 12 Glocal, 30 local and 114 internal streets and gates are in a tree-like cul-de-sac pattern. Internal streets and gates are mostly connected to Glocal streets, Local cul-de-sacs are all connected to Global roads. Within this street structure, the movement of automobiles are mostly two-ways but with three exceptions: 1) the flow from south along the east Global roads can not turn east and move along the south Global road; 2) the left section of one Glocal street is banned for cars, and 3) the two market streets allow no car movement (see Figure 5.N.15.3). On the other hand, there are also 28 bus lines running along all Global roads and the Glocal Street in the middle with 12 stops serving the Superblock (see Figure 5.N.15.4). In the future, there will be two subway lines running underneath the Global roads on the south and east sides. This means that public transportation relies on the four Global roads and one Glocal street that form a grid pattern with theoretically more movement in the future.

As discussed previously, the streets inside the walled compounds are not considered as part of the public street network. Those streets are ‘private’ and can be differentiated into publicly accessible and inaccessible streets as indicated respectively in green and blue lines in Figure 5.N.14.4. Publicly accessible streets only allow pedestrian and bike to move freely, cars are restricted unless permission is granted. Private inaccessible streets, on the other hand, allow no trespassing for all modes of travel. In each walled area, those private streets are grouped in fishbone, grid, loop or curvilinear patterns. Most walled compounds have one or more major trunk-like paths connecting to each gate plus some meandering narrow paths (usually less than 4m).
Figure 5.N.14.1 - Nanjing Supergrid and Daguangli Superblock - Global scale

Figure 5.N.14.2 - Daguangli Superblock and Environs - Supergrid roads and Glocal Street pattern

Figure 5.N.14 - Nanjing Supergrid and Daguangli Superblock - Street Pattern
Figure 5.N.14.3 - Daguangli Superblock - The Street Pattern - Local Superblock Scale

Figure 5.N.14.4 - Daguangli Superblock - the Pattern of Streets within Gated Communities
Figure 5.N.15.1 - Nanjing Supergrid and Jinyuan Superblock - Subway Lines and Stations

Figure 5.N.15.2 - Nanjing Supergrid and Jinyuan Superblock - Bus Lines and Stations

Figure 5.N.15 - Daguangli Superblock and Environs - Supergrid roads and Movement
(Drawings are made by author based on the information from Nanjing Metro 2012)
Figure 5.N.15.3 - Daguangli Superblock and Environs - Car Flow under Traffic Regulation

Figure 5.N.15.4 - Daguangli Superblock and Environs - Pedestrian Flow + Public Transport

Figure 5.X.15 - Daguangli Superblock and Environs - Supergrid roads and Movement
5.N.2.2 Investigation of Activity

5.N.2.2.1 Distribution of Activities:

Activities are mapped according to their distribution in building and space on the site (see Figure 5.N.16). The total number of each activity type is 1,278 for consumption, 340 for services, 72 for production and 6,984 for residential. In general, the distribution shows a clear separation of residential and non-residential activities in this Superblock.

By showing activities in sections and in separate layers (see Figure 5.N.17 and 5.N.18), three general findings are apparent. 1) The total number of consumption activities is much higher than the total number of all non-residential types. 2) While the non-residential activities tend to concentrate along the street block edges, residential activities are mostly located in the middle of each block. 3) The mixes of different activity types mostly occur along the street block and Superblock edges. However, because of the limited number of service activities, the mixes of production activities with other activity types are rare to find on this site and therefore shows no clear distribution patterns.
Figure 5.N.16 - Daguangli Superblock - Distribution of Four Major Functional Uses/Activities

Figure 5.N.17 - Daguangli Superblock - Street Sections with Activities on Different Levels
Figure 5.N.18 - Daguangli Superblock - The Distribution of Different Functional Use/Activities
Figure 5.N.18 - Daguangli Superblock - The Distribution of Different Functional Use/Activities

- Consumption + Service
- Production + Service
- Consumption + Production
- Consumption + Production + Service
5.N.2.2.2 Variety of Activities

The variety of uses of buildings and spaces is shown in Figures 5.N.19.1&2 and 5.N.20. The results indicate that consumption activities have the greatest diversity than service and production types because most building uses are related to consuming goods. While shops are the most numerous, industrial-related uses, such as factory and warehouse, cannot be found on this site. This implies that the site is not zoned as an industrial area. In comparison, street vendors are mostly related to service activities, like washing cars, amending things, advertising new housing properties or public dancing.

Figure 5.N.21 shows the uses across different levels of buildings, and it indicates a great deal of mix. Two key observations can be concluded: 1) most consumption related activities, especially restaurants and shops, are located on the ground floor of each building; 2) the variety of uses get fewer as building level gets higher, and they are limited to four major uses: hotel, government office, private office, and hospital.
Figure 5.N.19.2 - Daguangli Superblock - The Variety of Non-residential Uses in Buildings

Figure 5.N.20 - Daguangli Superblock - The Variety of Uses in Streets
Ground Floor

- Restaurant
- Entertainment
- Store
- Hospital
- Hotel
- Bank
- Gym
- Company
- Post Office
- Government & Community
- Convenience Store
- Fix and Amend

Second Floor

- School
- Police
- Market/Supermarket
- Petrol Station
- Public Toilet
- Real Estate
- Logistics
- Laundry
- Age Care
- Parking
- Broadcasting
- Tourist Agent

Third Floor

Fourth Floor

Figure 5.N.21 - Daguangli Superblock - The Variety of Building Uses on Different Floor
Figure 5.N.21 - Daguangli Superblock - The Variety of Building Uses on Different Floor
5.N.2.2.3 Intensity of Activities

The intensity of activity mix is measured according to the number of activity types on the horizontal level and across vertical levels. These are shown in Figures 5.N.22 and 5.N.23 respectively.

Horizontally, almost a quarter of the area has high levels of intensity (indicated in dark pink and red) and they tend to gather in groups or occur along the edges of the eight street blocks. Over three-quarters of the area have low to medium levels of intensity (indicated in grey and pink). Of these, 30.5% of the area can be found in relation to the mix of two types of activity and 45.6% of the area is served only by one type of activity. This creates a clear distinction between the concentration of high intensity at the street block edges and low intensity in the middle areas of these blocks.

Vertically, the intensity of the mix of activities illustrates a similar distribution pattern as found on the horizontal level. High intensity also occurs along the edges of each street block, especially around the northeast and southeast intersections of the Superblock. In the middle of each street block, the intensity is low as these areas are used essentially for residential purposes.
Figure 5.N.22 - The Horizontal Intensity of Functional Activity

Figure 5.N.23 - The Vertical Intensity of Functional Activity
5.N.3 Section Three: Interrelationships
Integration

Connection

Interaction

Photos: By Author
5.N.3.1 Integration

Space Syntax is used to understand the space-to-function relationship by analyzing the spatial configuration of Nanjing Supergrid and Daguangli Superblock. Similar to the analysis of the previous case study, street networks across Global, Glocal and Local scales are analyzed and discussed in this section.

5.N.3.1.1 Analysis of the City Street Network of Nanjing

The integration analyses of all the public roads and streets in the city of Nanjing are indicative of levels of movement, which further have implications for activities intensity. The global integration (R=n) indicates a 'spiky potato' configuration – that is, decreasing levels of integration in the global network as one moves away from the crossing of the two red lines towards the outskirts of the city (see Figures 5.N.24.1). It is of interest that, the two red lines are not only the city axes, which were originally envisaged in the 1929 Capital Plan, they are also the most integrated Global roads of the modern city. The underlying radial spatial feature or the 'spiky potato shape' in the 1929 Plan is well detected in this analysis.

However, local integration (R=3) shows a very different distribution pattern in which relatively higher levels of integration are distributed more extensively across the network (see Figure 5.N.24.2 and 5.N.24.3). It shows two major patches of well-integrated areas, which are also the two more commercialized and synergistic area of the city. It means that this urban structure can generate multi-directional movements with a generally distributed intensity of functional activities across wide areas of the city. Supposedly, this is because of the shift in planning from the 1929 radial structure to a Supergrid. However, the Capital plan still pose some impacts on the level of integration of the city network because the analyses show a very low integration between global and local scale.

Daguangli Superblock is located on the edge of a more or less well integrated part of the city with well-integrated Global roads on its four sides in both maps. However, the streets within the Superblock are not well integrated as they show low levels of integration in both maps.
Figure 5.N.24.1 - Nanjing - The global integration analysis of the whole city network

Figure 5.N.24.2 - Nanjing - The local integration analysis of the whole city network

Figure 5.N.24.3 - Nanjing Scatter Plot - Showing a moderately Low Global-Local Integration

Figure 5.N.24 - Space Syntax Analysis - City Network

Level of Integration

- High
- Low

Global Mean: 1.03
Local Mean: 2.05
Connectivity: 4.46
5.N.3.1.2 Global Integration (the Supergid)

Figure 5.N.25 shows the analyses of global integration (R=n) of the Supergrid only. This Global roads network realizes quite even measures of integration across most of the Grid. Higher levels of integration are relatively widely and evenly distributed as indicated by the red and orange lines. Following Space Syntax theory, the map indicates that the Global road network should, therefore, have relatively even volumes of traffic and activity intensities across the grid.

Although being on the edge of the Supergrid, the four Global roads around Daguangli Superblock indicate a moderately high level of integration in the Supergrid. However, the four Global roads all show low integration values of 1.0 (west), 0.98 (south), 0.95 (north), and 0.86 (east) for each road. This suggests that the highest movement and activity are along the west side. While this is largely true for movement, activity intensity along this road is the lowest among the four roads.
Figure 5.N.25 - Nanjing - The Global Integration of the Supergrid

- Spatial Accessibility/Connectivity
- Level of Integration

- Global Mean: 0.71
- Connectivity: 3.25

Ref Number 429
5.N.3.1.3 Glocal Integration (between Superblocks)

The integration of the street network at Glocal scale is indicated in Figure 5.N.26.1 and 5.N.26.2 respectively. The consistency of the two maps indicates some more integrated edges (the Global roads) and some less integrated glocal streets in the middle area. Also, the Glocal streets within Daguangli Superblock are much less integrated to the Glocal street network in the area of nine Superblocks.

The global integration of the network demonstrates that the Global roads and their sidewalks streets on the south and west edges are more integrated (in red), and they have the same integration value of being 1.84. In comparison, other Glocal streets are all in either blue or green color with integration value ranging from 0.87 to 1.39. This implies that the Glocal streets on the north and west edges are the most integrated, which implies that they should have the highest intensity of movements and activities.

On the other hand, the local integration of the network shows a very different distribution pattern. The Glocal streets on the north and east edges are more integrated than other Glocal streets within Daguangli (in orange) with an integration value of being 2.83 and 2.75 respectively. This implies a higher movement and activity intensity along these roads and streets. The Global roads on the west and south edges and two Glocal streets (in yellow) have a similar integration value ranging from 2.10 to 2.55. The most locally integrated streets are not related to this study site, but in general, Daguangli shows a moderate level of integration of the Glocal street network in this area of nine superblocks (Figure 5.N.26.3).
Figure 5.N.26.1 - The Global Integration of the Glocal Network

Figure 5.N.26.2 - The Local Integration of the Glocal Network

Figure 5.N.26.3 - Scatter Plot Showing a Moderate Level of Global-local Integration

Global Mean: 1.17
Local Mean: 1.63
Connectivity: 3.18

Level of Integration

High
Low

Figure 5.N.26 - Daguangli Superblock - Street Network (Global and Glocal) Analysis at Glocal Scale
5.N.3.1.4 Local Integration (within the Superblock)

The street network within Daguangli Superblock is also analyzed through Space Syntax as indicated in Figure 5.N.27.1 and 5.N.27.2, which show two conditions: 1) publicly accessible streets for both cars and people; and 2) accessible streets for people only (including private accessible streets).

The local integration (r=3) analysis of the street network within Daguangli shows two Glocal streets and the North Global road being the most integrated into the network with integration value of 3.81, 3.22 and 3.15 respectively. This indicates that those streets are more integrated into the street network within the study site with higher intensity of movement and activities.

In comparison, by including the privately accessible streets, the local integration of the street network of Daguangli demonstrates a very similar distribution pattern. While the most integrated streets remain the same, their integration values are slightly changed to 3.87, 3.22 and 3.23. The North Global road becomes a slightly more integrated than the other Glocal street.

According to the mapping of activities in the previous section, while these roads and streets are associated with many activities, the space syntax analysis can only explain part of the activity distribution of the site.
Figure 5.N.27.1 - Daguangli Superblock - The local Integration analysis of the Street Network within the Study Site - Publicly Accessible Streets Only

Local Mean: 1.85
Connectivity: 2.53

Figure 5.N.27.2 - Daguangli Superblock - The Local Integration of the Local Network with Accessible Private Streets

Local Mean: 1.77
Connectivity: 2.83
5.N.3.2 Connection

5.N.3.2.1 Street Patterns and Activity Types

Non-residential activities occur in certain places in the Superblock as indicated in Figure 5.N.28. The percentages of the distribution of consumption, service and production activity that are adjacent to the roads and streets of the grid pattern are 66%, 67%, and 83%, while their occurrence in cul-de-sac patterns are 33%, 27%, and 32% respectively. Residential activities are mostly related to the private street networks within the walled compounds. More specifically, 76% of consumption, 71% of service and 83% of production activities are located around cul-de-sacs that serve as gates to compounds.

From the four maps and data on the next page, three general findings can be concluded. 1) All types of non-residential activities are more related to the grid pattern than the tree/cul-de-sac pattern. 2) While consumption and service activities are more associated with the Glocal grid, more production activities are found along the global grid than with other patterns; 3) All types of activities have stronger relationships to the gates rather than streets.
Total: 1278 (including one street markets)
Global Grid: 381    Glocal Grid: 462
Cul-de-sac: 427; 325

Total: 340
Global Grid: 92    Glocal Grid: 127
Cul-de-sac: 102; 72

Total: 72
Global Grid: 37    Glocal Grid: 23
Cul-de-sac: 23; 19

Total: 122
Global Grid: 20    Glocal Grid: 86
Cul-de-sac: 19

Figure 5.N.28 - Daguangli Superblock - Connection between Street Pattern and Activity Distribution
5.N.3.2.2 Street Types and Activity Types:

Figure 5.N.29 illustrates the distribution of the three non-residential activity types associated with each street type. The numbers of each type of activity along each street type are indicated below each map. The results indicate that the more activities are located along the Glocal streets than to other street types. Most (72%) consumption activities are located also along Glocal streets. The proportions of each activity type locating around Local and Internal gates are 58% and 80% for consumption, 52% and 26% for production and 52% and 53% for the service activities. The activity density along each street type suggests that the general distribution of activities is relatively even in this Superblock. While the Glocal-Internal type of connection is related to more activities than the Global-Local type of connection, Global road type still has a slightly higher activity density than Glocal street type (see Figure 5.N.29. table).

Those numbers indicate four general distribution patterns. 1) Most non-residential activities are located along the Global roads and Glocal streets, with a relatively stronger relationship to the Glocal street Network. 2) Consumption activities have a strong presence on all street types, while service and production activities do not show a clear relationship to any street type. 3) Activities are more associated with Local and Internal gates than streets. This shows that the gates of the walled compound are key exchange points affecting the flow of people, and business takes advantage of this structural element to realize the 'movement economy'.
Figure 5.N.29 - Daguangli Superblock - Connection between Street Types and Non-residential Activity Distributions
5.N.3.2.3 Street Types and Building Uses:

In more detail, the distribution patterns of specific building use in relation to different street types are indicated in Figure 5.N.30.

1) Most shops (over 85%) are related to the Global roads and four Glocal streets that together form a grid pattern.

2) Most food outlets (over 73%), including convenience stores (but excepting street vendors), gather around the gates of walled communities, and about entrances to public congregation spaces such as parks, squares, hospitals, and schools.

3) Restaurants can mostly be found in four loose clusters, three of which relate to Global-Glocal and Glocal-Glocal junctions.

4) Entertainment venues for Mahjong, KTV and clubs are usually found along Global roads and Glocal streets with little relatedness to gates.

5) Most (80%) of banks are related to Global roads: the rest are found along Glocal streets and none are related to gates.

6) Most of the schools, hospitals, and hotels tend to locate along the Global roads and major Glocal streets with a clear relationship to gates.

7) All kinds of commercial offices and financial institutions are found along Global and Glocal streets showing no clear relationships to gates.
Figure 5.N.30 - Daguangli Superblock - Connection between Street Types and Building Uses
5.N.3.2.4 Street Densities (Junctions) and Activity Types:

The relationships between street junction and the distribution of activities are indicated in Figure 5.N.31. The maps show strong correlations between all non-residential activities and T-sections (80% for consumption, 78% for service and 67% for production activity) – stronger than with intersections. Most (62%) non-residential activities together are associated with T-sections in the form of gates (78% for consumption, 45% for service and 24% for production activity). Among them, 61% are Global-Local T-sections, and 27.1% are Glocal-Internal T-sections.

The statistics indicate two important relationships: 1) more (55%) consumption activities are related to T-sections as in the form of Global-Local Gates. The Global-Glocal and Glocal-Glocal junction together show the strongest relationship (42%) to all non-residential activities of all types, and the Global-Glocal junctions has the highest relevance (13%) to all non-residential activities among all junction types. The important message here is that the Global and Glocal junctions attract more consumption and service activities reflecting higher flows of people in this Superblock.
Figure 5.N.31 - Daguangli Superblock - Connection between Street Junctions and Activity Distribution
5.N.3.3 Interaction

5.N.3.3.1 Street Types and Activity Mix:

As indicated in Figure 5.N.32, among the four types of non-residential activity mixes, the most common in Daguangli Superblock is consumption-service mix (53.7%), which is well ahead of consumption-production mix (31.7%), production-service mix (7.3%), and the mix of the three types (7.3%). Consistently, these activity mixes show stronger relationships to Global roads than all other street types.

More specifically, consumption-production and consumption-service mixes show a moderate relationship to Global (over 40%) and Local streets (more than 30%). They also show stronger relationship to Internal gates (18.2%) than Internal streets (9%). Given the scarcity of service-production and consumption-service-production mixes, the data may be of limited significance: however, it is worth noting that the few mixes of these types that do occur are found only along the Global roads and show no relationship to Internal streets.
Figure 5.N.32 - Daguangli Superblock - Interaction between Street Types and Functional Mix
5.N.3.3.2 Street Types and Building Use Mix:

More detailed examples of potential Interaction between functions and streets are shown on maps in Figure 5.N.33. This clearly demonstrates how building uses are mixed and able to support each other to provide convenience through their proximate locations in the street network. While correlations are not absolute, the three example pairs of activity mix indicate likely relationships.

The first pair of maps indicates where people go to schools and hospitals for public services and where they can get access to restaurants. This shows how service and consumption activities are mixed through the street network. The results indicate 75% of schools and 52% of hospitals are located in proximity to restaurants (that is, next to or within 50m).

The second pair of maps indicates where people have access to hotels and restaurants. This shows how service and consumption activities are mixed with the support of the street network to provide more closeness. The result indicates that all users of hotels can access restaurants within 100m.

The third pair of maps indicates where people work in offices, where they can access banks and where they can buy items from convenience stores. This is to show the mix of all three types of activities and the role of the street network in providing channels to connect and reduce travel distances between the three. The result indicates that in over 80% of cases, the three types are either next to each other or locate within 100m of each other.
Figure 5.N.33 - Daguangli Superblock - Interaction between Street Network and Building Use
5.N.3.3.2 Street Densities (Junctions) and Activities Mix

As indicated in Figure 5.N.34, Among the mixes of all non-residential activities, 70% are related to junctions and, of these, two-thirds can be found around T-sections rather than intersections.

More specifically, the mix of consumption-service activities shows the strongest relationship to junctions, and it shows a stronger relationship to T-sections (75%) than intersections. Of these, 42% (the highest) are related to Global-Local T-sections (including gates). It is followed by the mix of consumption-production activities. 63% of this type of mix is also related to T-sections, and all are related to Global-Local T-sections. The mix of production-service activities and of all three types can only be found around junctions, without any further correlation with either T-sections or intersections.
Figure 5.N.34 - Daguangli Superblock - Interaction between Street Junctions and Functional Mix
5.N.3.3.3 Street Types and Activity Mix Intensities

In general, the intensities of activity mix on both the horizontal and vertical level in this Superblock show a clear separation between those areas with higher function mix and those with the single use.

The measures of intensity of the 'mix of mixes' on the horizontal level are illustrated in Figure 5.X.35.1. These also demonstrate a clear concentration of high intensity along the Global roads and Glocal streets, and these surround areas of 'Low' intensity. These places of higher levels of intensity (mixes of three and four types of activities) also show a clear relationship to Global-Glocal junctions. This again reflects the theoretical position whereby more functional mix will occur where there is a well connected structure of channels to support movement and interaction between activities.

Higher measures (mix of three and four activity types) of vertical intensity are mostly concentrated along the Global and Glocal streets (Figure 5.X.35.2). Very few activity mixes can be found in the interiors of areas enclosed by the Global and Glocal streets. Together, this shows a clear separation between high and low intensity. Moreover, the 'Very High' (in red) intensity occurs essentially along the Global roads and particularly around Global-Glocal junctions. Most Local and Internal gates relate to places of 'Medium' level intensity (light pink).
Figure 5.X.35.1. The Mapping of the Intensity on Horizontal Level

Different Street Types

Different Street Junctions

Figure 5.X.35.2. The Mapping of the Intensity on Vertical Level

Different Street Types

Different Street Junctions

Figure 5.N.35 - Daguangli Superblock - Interaction between Street Network and Function Mix Intensity
Fundamentally, the analysis of the Daguangli Superblock reveals that the wall and gate structure as part of the cultural influence have a tremendous impact on shaping the morphology of the study site. It results in a specific pattern and types of connection in the local street network, which further affects the movement and distribution of functional activities in this study area.

The street network in Daguangli is put together in two major combinations: the Global grid connecting with Local streets and gates, and a Glocal grid linking with Internal streets and gates. There are more Glocal-Internal connections than Global-Local connections forming a denser grid at the Glocal scale. This type of connection creates more T-sections than intersections, especially Internal T-sections in the form of gates. As a consequence, movement from the Local and Internal gates are fed directly onto Global roads and Glocal streets, with a particularly high volume through Glocal streets. Nevertheless, most of the Glocal streets are not well connected and integrated to the wider street network. This means that people and cars cannot travel very far through these Glocal streets, and hence are forced back to the Global roads.

On the functional side, the distribution of activities shows a pattern of strong concentration of non-residential activities along the Global roads and Glocal streets. They surround and separate the residential uses into several groups. While consumption, production and service activities all demonstrate similar distribution, Consumption activities are by far the most numerous with the highest diversity. Mixed activities also tend to gather along the Global roads, and since street activities are found in association with these mixed activity areas, further intensification occurs.

On the city level, the space syntax analysis of the Nanjing Supergrid indicates a network with a moderate level of integration in general, but the four Global roads of Daguangli are relatively more integrated than the other Global roads in the network. However, the Glocal streets within Daguangli are not well integrated into the street network within the area of nine Superblocks, despite the West and South Global roads are the most integrated in the area. Within the Superblock, the street network indicates that two Glocal streets and the North Global road
are the most integrated into the local street network. However, space syntax analysis does not fully reflect the distribution of activities on the site. While the measures of integration of the street network across scales imply a higher level of traffic flow and activity intensity along the North, West and South Global roads and two Glocal streets, the actual result indicates a different story. Not only the West Global road has the lowest activity concentration, activity concentrations in other parts are also not detected by the analysis. These inconsistencies are because of the lack of well-integrated Glocal streets to wider street network and the inefficient traffic control in and around the study site. Again, this reflects a locally well-integrated street network, which is not well-integrated into the network at Glocal and Global scales showing clear fragmentations.

The analysis of connection indicates a strong interrelationship between the Glocal street network and non-residential activities, particularly of the consumption type. There is also a clear relationship between activities and the Local and Internal gates, which are mostly attached to the Glocal streets. In other words, Glocal streets become the predominant network that attracts the largest number of activities from Internal streets and gates. According to the theory, this is because Internal gates are the major threshold of movement and flow, which attracts more functional uses and business to set up around gates to capture the movement economy. In comparison, Global roads also show a clear relationship to activities, but the number of activities along Global roads is less than it along the Glocal streets. This is again because of the strong Glocal-Internal type of connection of the street network. More specifically, uses such as restaurants, convenience stores, and markets especially favour gates. Hence, connections between the street network and activities are greatly affected by the number and location of gates.

In the analysis of interaction, the co-functioning of activities can be found in a distributed fashion in both horizontal and vertical associations. Consistently, they tend to gather along the Global roads, Glocal streets and around the T-junctions between Global and Local gates and streets. The intensity of activity mix on the horizontal level is stronger than it on the vertical level, and they are both strongly related to the location of gates. While the highest intensity cannot always be found around the gates, most gates are related to activity mixes of least two types.
5.C Discussion and Comparison:

This chapter discusses the two Chinese Superblocks as case study sites in the context of the Supergrid networks of Xi’an and Nanjing. They represent two typical Superblock structures in Chinese cities: the former is in the central area of a Supergrid but with a poorly connected structure, while the latter is on the edge of a Supergrid but has a much better-connected structure within the Superblock. This particularly implies that the situation (central or edge) of each Superblock in a Chinese city Supergrid in Chinese cities does not directly affect the connectivity within each Superblock: this is because each Superblock can have a more self-contained network system within, while the Supergrid can provide a multi-directional network around and beyond. More importantly, both Superblocks show a pervasive use of wall structure, which is very prominent part of the city structure in various historical transformations reflecting the strong influence of the wall-oriented spatial conception as discussed in Chapter Two. Both Superblocks have an issue with their Glocal streets, which are poorly integrated at Glocal scale.

5.C.1. Form and Function Interrelationship:

While the Supergrid in Xi’an contains a more formal and regular grid layout, Nanjing has a Supergrid that is much more deformed by the natural landscape and irregular in shapes. The Global road interval is also smaller in Nanjing than in Xi’an on average, and this makes a denser network in the former than in the latter one. Despite this difference, they both adopt the central idea of using a Supergrid as the city skeleton and many major Global roads from the ancient times were kept in use as part of the modern Supergrid.

The above discussions indicate three important characteristics of the form-function interrelationships in the two Superblocks. 1) ‘Gate-ism’: mixes and concentrations of activities tend to favor locations at and around the gates of walled compounds of both sites. 2) ‘Movement-transfer-ism: a wall and gate structure can redistribute activities by changing the connectivity of the street network, which further affects movements of all modes of travel. Activities also gather in places where different street types connect to each other creating a
mix of physical forms, which in turn mix traffic modes that further attracts different activities.

3) ‘Parasite-ism’: non-residential activities are like parasites that gather in places where movement and activities are concentrated, which is usually where a mix of street types and gates occur.

The general morphologies of the two Chinese Superblocks share some similar characteristics, and one of the most important features is the wall and gate structure, or the 'gate-ism'. The two study sites represent two typical street networks that can be commonly found in Chinese Superblocks. Jinyuan presents an extreme of having a maze-like wall and gate structure that takes over from the limited number of streets. Daguangli, in comparison, represents another extreme of having a structure that has a more well-connected street network, which co-exists with a wall structure in a consistent way. The ‘walls and gates’ and streets together construct a structure with the former as a dominant tool for spatial demarcation and traffic control and the latter to channel traffic flow to the Supergrid. This demonstrates that movement is dramatically changed by the wall structure, and the gates naturally become the favorite spots for activities that rely on movement.

More importantly, this ‘wall and gate’ structure is also responsible for creating a strong concentration of mixed non-residential activities and their clear separation from the residential activities. The analysis in this chapter indicates a strong correlation between the location of the gates and all kinds of non-residential functions, especially consumption activities. The Jinyuan Superblock has more gates along the Global road creating a stronger commercial edge, whereas the Daguangli Superblock contains more gates along the Glocal streets, which have the effect of subdividing the Superblock into a number of street blocks (but unlike Western street blocks) again forming a commercial edge around each block. This shows an extremely interesting impact of walls and gates and their ability to influence the distribution of activities, especially consumption activities.

This condition is clearly explained by the structure-movement-activity interplay ideas of the Interconnection Theory. The Supergrid in Xi’an shows a better integration and more even
distribution of movement and activities than that of Nanjing. The Glocal streets around Daguangli indicate slightly higher integration values than those of Jinyuan (in the areas of the nine Superblocks). However, both Glocal street networks suffer from a lack of integration into the wider Glocal network even though more Glocal streets are to be found in the Daguangli than Jinyuan. This low integration continues to appear as an issue in the local street network within each Superblock. The space syntax maps of the two sites both show many short lines (mostly gates) along either Global or Glocal streets implying a high traffic volume and activity distribution. Global roads are the most integrated across scales and in Jinyuan, while in Daguangli, Glocal streets followed by Global roads are most integrated. It is under the impact of this dis-integration at a Glocal scale that people are forced onto Global roads for even their local and glocal movements. Even their use of public transportation is via the Global roads, where almost all service routes occur.

The same shortcomings are also found in the analysis of Connection. Activities tend to gather along the Global roads where most gates are located in Jinyuan, whereas they are relatively evenly spread along the Global roads and Glocal streets, which are also where most gates are located in Daguangli. In other words, while gates act as diffusers to release and gather movements of all modes, the way gates are connected to other street types forming T-sections become a predominant factor in activity distribution. To sum up, the walls and gates restructure the street networks to greatly affect traffic movement, the use of space and the distribution of activities since each gate becomes a focal point that controls traffic flow.

Moreover, the Interaction analyses of both sites indicate that the activity mixes tend to occur along the Global roads and around the Global-Local T-junctions in both sites. Moreover, street activities also tend to concentrate along Glocal streets or around the Global-Glocal junctions where numerous activities mix and concentrate. This creates an extra layer of intensity and implies that the Global-Local T-sections and Global-Glocal junctions are strategic locations, where activities can take advantage of the Global movements in the Supergrid to attract more activities.
5.C.2. Design Principles and Explanations

The following design principles can be summarized from the discussion above.

1) Walls and gates are used as tools for spatial and functional organization.

The most predominant design application in these two Chinese Superblocks is the pervasive use of the wall structure to demarcate space and reorganize the street structures. The street networks of both Jinyuan and Daguangli are clearly affected by the wall-oriented perception of space in Chinese culture as discussed in Chapter Two. It creates a ‘streets-walls-and-gates’ structure that redistributes the movement in all travel modes and further affects the distribution of activities through the grouping and separation of residential and non-residential buildings inside and outside of the walled compounds. Further, no clear relationship between street widths and building heights can be found except within each walled area.

2) The concentration (sometimes over-concentration) of activities along the Global roads.

The two sites indicate a strong relationship between non-residential activities and Global roads. Jinyuan Superblock has a strong Global-Local type of connection, which is responsible for an over-concentration of activities along the Global roads where most gates are located. In comparison, while Glocal-Internal type of connection is dominant in Daguangli Superblock with a relatively even distribution of activities along both Global roads and Glocal streets, more activities still concentrate along the Global roads. Mixes of all activity types (consumption, etc.) also show an invariable relationship to the Global roads in both sites.

This is mainly caused by the disconnection and disintegration of Glocal streets in the wider street network. With poorly connected Glocal streets in both Superblocks and similar conditions in their neighboring Superblocks, integration at the Glocal scale is poor and much
glocal and local traffic is diverted onto Global roads. The usual function of Glocal streets as effective channels between Superblocks is hugely reduced. The traffic controls in both sites also contribute to redirect the flows of automobiles onto Global roads. Moreover, since non-residential activities tend to mix together and intensify where traffic flows are highest (Interconnection theory), this puts enormous pressure on the Global roads of these Superblocks. While the wall structure can hinder movement, the more fundamental and damaging problem is the absence of a well-connected and integrated Glocal street network. With very few numbers of shortcuts and detours in the Jinyuan Superblock, an even stronger pressure is put on the wide Global roads and it creates an over-concentration of traffic and activities (severe traffic congestion is observed here during site visit).

3) The importance of 'street-gate' and 'global-glocal' junctions to activities.

Both sites indicate the strategic importance of the location of street-gate T-sections for generating and attracting activities. Jinyuan Superblock presents this as Global-Local T-sections and Daguangli as Glocal-Internal T-sections. Following these types, Global-Glocal junctions bear the next strongest relationship in generating the number and mix of activities in different types. Further, these locations are the nurturing grounds also for the street vendors. While streets markets are found in both Superblocks around Global-Glocal junctions, street vendors also concentrate around the gates to walled communities with different functions (residential, company or factory compounds).
4) A clear separation of non-residential and residential functions by the walls.

On the two sites, all non-residential activities are commonly mixed and this serves to intensify by attracting even more diversity of uses whereas residential activities are usually separated from the consumption, service and production activities by walls. At the same time, the number of consumption activities is much higher than production and service activities, and this is closely related to the flow of people, which is where the structure gives a higher accessibility and connectivity – in this case, the gates. Service, like consumption activities also tend to be around the Global road junctions with streets to maximize public accessibility for people from both within the Superblock and other Superblocks. In comparison, production activities are usually less dependent on and therefore less related to the flow of people.

The above findings reveal two typical Superblock structures within Chinese Supergrid systems. Although different, they both show a clear wall-orientation (as discussed in Chapter two), which has had a widespread impact on the form and function of Chinese cities. In comparison, the next Chapter will show how Superblocks can be formed with very different structures while still occurring within a Supergrid system in Japanese cities.
Chapter Six

Supergrid and Superblock Structure in Japan
6. Introduction: Superblocks in Kyoto and Osaka

‘As unplanned growth on the fringe gradually is incorporated into the urban fabric, the characteristic pattern of Japanese cities – bits of planned development surrounded by large areas of incremental, unplanned development – is repeated.’

Sorensen 2001, Introduction, p.5

Chapter Six discusses the Supergrid and Superblock Structure of Kyoto and Osaka in Japan. This chapter specifically focuses on the investigation of the Shijo-Karasuma Superblock in Kyoto and the Imazato Superblock in Osaka as two case studies.

Similar to the previous Chapter, this chapter also includes three major parts: 1) the investigation of the Shijo-Karasuma Superblock in Kyoto is the first case study; 2) the investigation of the Imazato Superblock in Osaka is the second case study; 3) a summary and comparison of the findings from the two sites that will inform some answers to the research questions (see Figure 6.0).

Each case study also includes four sections:

It starts with a discussion of the modern morphology of the Supergrid and Superblock structure and how it has transformed through history under the influence of the Japanese culture as a direct reflection of the literature review in Chapter Two. The major message of this section is that the Superblock structures in the two Japanese cities both have a ‘Hard-shell’ and ‘Soft yolk’ form and elements of the 'Oku' type of spatial conception. It reflects the Japanese Areal and floor-oriented spatial conception. More importantly, they do not have the wall and gate structure as found in the two Chinese Superblocks.

The second section is an exploration of the type, density, and pattern of street network and the distribution, variety, and intensity of activities. This section indicates how different elements of the physical system work with each other to create the form as a skeleton, and how various factors of the functional system cooperate with each other to generate activities.
The third section assesses the interrelationships through the investigation of Integration, Connection, and Interaction by using the method of superimposing street and activity maps as indicated in methodology chapter. This section reveals that the street network is the major influence on creating rather distributed activity patterns through movement in Japanese cities, and it also plays a determinant role in facilitating the generation of urban synergies.

The last section of each case study summarizes the key findings from the above three sections to reveal some interrelationships between the street network and functional activities in the selected Superblocks. It further concludes some commonly used design principles from the investigation of the two Superblocks under the Japanese cultural context.

Figure 6.0 - A Diagram Explaining the Content of Chapter Six
Shijo-Karasuma, Kyoto

烏丸 - 四条, 京都
Figure 6.K.1 - Shijo-Karasuma Superblock in the Kyoto Supergrid - Global Scale
(Adapted from Google Map by Author)
6.K Supergrid and Superblock Structure in Kyoto

Kyoto is about 827.83km$^2$ in size with a highly urbanized area of 160km$^2$ (16X10km), which is where the Supergrid locates. The case study site, Shijo-Karasuma Superblock, is chosen in the central area of the Supergrid as indicated in Figure 6.K.1. The Supergrid is quite regular in the middle area but it starts to deform when it encounters mountains and rivers. Each Superblock is typically about 1km$^2$ in size, but the intervals of the Global roads vary. The selected Superblock has a regular shape and it is slightly less than 1km$^2$ as indicated in Figures 6.K.2 and 6.K.3, which show the study site at Glocal and Local scales respectively. It fits the requirement for having a study site in a central location of a Supergrid as discussed in chapter 4.

The size of the Shijo-Karasuma superblock is about 0.6km$^2$, 820m in length and 700m in width. The total built area is about 0.4km$^2$ with a population density that ranges between approximately 160 people/ha by day, and 120 people/ha by night (Kyoto City Official Website 2000, p.11 & 12). The population of this area is rather mixed with more seniors than young people. Functionally, it is part of the commercial center of Kyoto, and therefore spatially it is very important to the Kyoto city.
Figure 6.K.2 - Shijo-Karasuma Superblock in its Supergrid Environs - Glocal Scale
(Adapted from Google Map by Author)

The Study Site
The Supergrid

Figure 6.K.3 - Shijo-Karasuma Superblock - Local Scale
(Approx. 0.6 km²)
(Adapted from Google Map by Author)
6.K.1 Section One: Cultural Influence

6.K.1.1 The Cultural Influence on the Formation of the Shijo-Karasuma Superblock

While the Supergrid and Superblock structure is constructed in modern times, it is formed under a series of historical transformations that are influenced by the floor-oriented Areal spatial conception of Japanese culture. Figure 6.K.4 indicates the physical form of the Superblock, which contains 2,534 individual buildings in different sizes that are densely packed with each other with a 60% of site coverage. The most pervasive type of building in this Superblock is the pavilion in groups and row house in both traditional and modern style. The pavilions and row houses are usually 1-3 story high and 3 to 6m wide as houses or shop houses. Towers can be up to 30 stories high in various widths. It shows a very regularly formatted fine grain and texture as the basic morphology in its current condition (2016).

Three important messages can be summarized:

1) The Superblock is extremely regularly arranged and constituted by a number of blocks in two sets of similar sizes and shapes.

2) Buildings of different sizes and shapes are all densely mixed together and arranged to cover the whole area of each street block, reflecting the floor-oriented Areal spatial conception.

3) A ‘Hard-shell’ form can be found with four strong edges of relatively tall buildings as affected by Japanese planning regulation.
Figure 6.K.4 - Shijo-Karasuma Superblock - 3D Model (Top) and Figure Ground (Bottom)
6.K.1.2 The Formation of the Modern Supergrid and Areal Thinking:

Several major transformations of the city are indicated in Figure 6.K.5.1. The city in Heian Period adapted the Supergrid and Superblock structure from ancient Xi’an (see Figure 6.K.5.2). It was built on a system of 'big roads (25m) and small streets (less than 10m)' as a multi-directional network without a wall structure around each Superblock (Yasuo et.al. 1993 & Stavros 2005). This Supergrid created a number of Superblocks, which was composed of some street blocks with a similar size (typically 120X120m) for equal land distribution. The structure was later diminished and changed into a street block structure in the Medieval Period (see Figure 6.K.5.3). With the decline of the West part, the Eastern part became the major city area and was divided into the North (Kamigyo) and South (Shimigyo) sections since the 12th century. Part of the two sections was walled with only one road (Muromachi) linking them because of many internal wars as indicated in Figure 6.K.5.4 (ibid). In Edo period, the two sections were reintegrated and converted into a castle town by Hideyoshi’s city reconstruction (see Figure 6.K.5.5). The street block structure was further subdivided into half-sized rectangular blocks by creating more north-south direction roads, and this made a major structural change (ibid).

Built upon this castle town block structure, a Supergrid and Superblock structure reappeared under two major impacts since the 20th century. The first impact is the introduction of new types of transportation and the need for city expansion and connection. A network of tram lines was constructed in the early 20th century and formed the first embryonic Supergrid network. It was later converted into wide Global roads to accommodate automobiles. Secondly, it is formed under the land readjustment and road widening process (see Figure 6.K.5.6).

In the process, it is clear to see that the street block structure has been used consistently, whereas the Supergrid and Superblock structure has usually been implemented when large scale city developments are needed. This structure allows cities to expand in all directions and implies the Areal spatial conceptions as a key rule that guides the transformation. This has been best exemplified in modern times when the city reaches its greatest extent.
Figure 6.K.5.1 - The Modern Supergrid Network and Its Relationship to the City in Different Periods of Times

Figure 6.K.5.2 - Kyoto in Heian Period (Drawn by author based on Yasuo et al. 1993)

Figure 6.K.5.3 - Kyoto in Medieval Period from 12th-13th Century (Drawn based on Yasuo et al. 1993, & Stavros 2005)

Figure 6.K.5.4 - Kyoto in Azuchi Momoyama Period (15-16th Century) (Yasuo et al. 1993, p.130)

Figure 6.K.5.5 - Kyoto in Edo Period (17-18th century), (Yasuo et al. 1993, p.188)

Figure 6.K.5.6 - Kyoto in 19-20th Century, the map shows the city network since the 19th century and the Tram network in 1925, (International Research Center for Japanese Studies 2016a)

Figure 6.K.5 - Kyoto Supergrid History – Structural Transformations (Urban History Map Editorial Committee 1999)
6.K.1.3 Historical Transformation: The Floor-oriented Spatial Conception

The Shijo-Karasuma Superblock is one of the areas that have been included as part of the city structure since the beginning, and it has been highly influenced by all changes of the Supergrid as discussed above. The major evolution of the Superblock can be summarized as six major stages (see Figure 6.K.6.).

The earliest form within the Shijo-Karasuma Superblock contained the area of 30 street blocks from four different Superblocks (about 0.25km$^2$ each), which were separated by the Global roads of the ancient Supergrid as indicated as the red dotted lines. The two Global roads were later diminished during the Medieval Period. Half of the size of Shijo-Karasuma was enclosed by a wall structure as indicated in stage two, but the walls were later demolished. Under Hideyoshi’s redevelopment in Edo period, more north-south direction streets were added to make smaller blocks as the structure of castle town as indicated in stage 3. This structure was basically kept as the base of the modern Superblock as indicated in stage 4. While most streets and blocks remained the same, only one long block in the southwest corner and more bridges over the water channels were constructed. The next change occurred in the modern period since the 1920s with the introduction of a tram network. One of the tram lines was built to go through this area by filling the water channel in the middle. The last stage of transformation was the street widening. The Global roads on the south and west edges were widened to 50m. The roads on the north and east edges were redeveloped but remained relatively narrower. The new Global roads on the north and south sides interestingly coincide with the ancient Shijo and Gojo Global roads in Heian-Kyo. The road on the west edge of the study site was a river and transformed into a wide Global road. The two Global roads in Heian-Kyo were also converted into Glocal streets with the removal of the tram lines.

The structural transformations of the Shijo-Karasuma Superblock indicate the tenacity of the original block structure to persist. Although walls were constructed in part of the Superblock for a short period of time, they were not used to surround any Superblocks. In other words, spaces have been mostly maintained as inclusive areas without strong boundaries and this reflects the floor-oriented spatial conception.
Stage One: Heian-Kyo 8AD-13BC

Stage Two: Upper and Lower 15BC-16BC

Stage Three: Castle Town 1693

Stage Four: Pre-Modern 1800-1900

Stage Five: Pre-Modern 1920-1960

Stage Six: After 1960

Figure 6.K.6 - Shijo-Karasuma Superblock - Historical Transformation
(Drawings are made by the researcher according to a number of maps from Takahashi et.al. 1993, Stravos 2005 International Research Center for Japanese Studies 2016a, and Moriya, K. Sen, S. 1994)
As discussed before, the street block structure has been adopted consistently through various transformations with few impacts from the walls. The modern structure also carries on this characteristic, which is indicated in Figure 6.K.7 and 6.K.8. They show the street and block structure and the sizes and shapes of each block within the Superblock respectively. The two red dotted lines, which represent the two Global roads in Kyoto in Heian period, separate these street blocks into four quarters. The blocks in the first quarter are mostly 120X120m with an average size of 12,335m², which inherit Heian-kyo’s checkerboard layout. The blocks in the other three-quarters are mostly about 60X120m with an average size of approximately 7,800 m², which were formed under Hideyoshi’s city redevelopment. 86% of the blocks are more than 7,018m², and only 2% of them are less than 1,350m² (the blue ones). In general, the structure has a fairly equal size and regular shape.
Figure 6.K.7 - Shijo-Karasuma Superblock - Streets and Blocks

Figure 6.K.8 - Shijo-Karasuma Superblock - Block Sizes
6.K.2.1 Investigation of the Street Network

6.K.2.1.1 Street Types

With such regular blocks, the street network is also fairly regular and evenly distributed. The four street types are structured as a hierarchical network as indicated in Figure 6.K.9 and 6.K.11. Each street type not only provides a different level of connection but also shapes the built form on its two sides by slope planes (see Figure 6.K.10).

The four Global roads provide city-wide travel and are all flanked by sidewalk streets. The Global roads on the North and South edges are connected by Glocal and Local streets, while the other two are only linked through Glocal streets. The South and West Global roads are 50m with 6-8 car lanes, but the other two are 30m and 26m respectively with only 4 car lanes. Buildings on both two sides of each road are also affected by slope plane regulation and are higher along the wider South and West Global roads. The sidewalk streets are narrower along the North Global roads but wider on the other three sides. Two subway stations and two bridges provide underground and above ground connections to cross the Global roads.

14 Glocal streets provide medium-distance travel to the 8 neighboring Superblocks of Shijo-Karasuma. Their widths vary from 4.5m to 15m and often do not have a consistent width throughout their whole lengths. Crossings, bridges or underground walkways are the extended parts of Glocal streets to provide connections to the other side of the Global roads. Most Glocal streets are shared space, although some have sidewalks. The buildings along the Glocal streets also vary in shapes and heights, the higher ones have either slanted fronts or large setbacks.

Seven Local streets can be found within the Superblock with widths ranging between 3 and 5m. Buildings on the two sides are mostly low (up to three stories) with a few residential towers. Internal streets are from 2 to 6m wide with an average length of 4.1m. They are mostly formed to provide direct access to individual properties. Both Local and Internal streets are shared space, and Internal streets have a sense of semi-private space for people and cyclists while other street types do not have.
Figure 6.K.9 - Shijo-Karasuma Superblock - Street Network and Types

Figure 6.K.10 - Shijo-Karasuma Superblock - Examples of Road/Street Types in Sections showing the dramatic change in width and building sizes along the streets
Figure 6.K.11.1 - Global Roads

Figure 6.K.11.2 - Glocal Streets

Figure 6.K.11 - Shijo-Karasuma Superblock - The Four Street Types
Figure 6.K.11.3 - Local Streets

Figure 6.K.11.4 - Internal Streets

Figure 6.K.11 - Shijo-Karasuma Superblock - The Four Street Types
6.K.2.1.2 Street Densities (and Dimensions):

Figure 6.K.12 indicates the number of the four street types and their average widths, lengths, and densities. The numbers of Global, Glocal, local and internal streets in proportion to the total number of streets are 0.06, 0.2, 0.11, 0.63, and the density of each street type is 5.13, 15.55, 4.17 and 3.73 km/km² respectively.

The Global roads are the widest on average and they are more than 4 times wider than Glocal streets. While Internal streets have the largest number but lowest density. Glocal streets show the highest street density, which are more than 3 times higher than other street types. The street width and density of Local and Internal streets are very close, but Internal street length on average is the shortest of all types. According to those numbers, Glocal streets providing medium distance travel to wider area is a major type of connection of this Superblock. Moreover, the Global sidewalk streets show a similar width with Glocal streets. This reflects Shelton’s statement that the Global sidewalk streets are highly likely to be part of Glocal street network.
Figure 6.K.12 - Shijo-Karasuma Superblock - Key Dimensions of the Four Street Types

- **Street Density**
  - km/km²
  - Global Road: 5.13
  - Global Street: 15.5
  - Local Street: 21.1
  - Internal Street: 4.17
  - Average Street Width: 3.73

- **Number of Streets**
  - Global Road: 4
  - Global Street: 13
  - Local Street: 7
  - Internal Street: 40

- **Average Street Length**
  - Unit: m
  - Global Road: excl. Global Sidewalk St
  - Global Street: incl. Global Sidewalk St
  - Local Street: excl. Global Sidewalk St
  - Internal Street: incl. Global Sidewalk St

- **Average Street Width**
  - Unit: m
  - Global Road: 40
  - Local Street: 8.5
  - Local Street: 7.3
  - Internal Street: 4.3
  - Internal Street: 4.1

Figure 6.K.12 - Shijo-Karasuma Superblock - Key Dimensions of the Four Street Types
6.K.2.1.2 Street Densities and Dimensions: Junction Analysis

The density of the street network can also be understood as the density of junctions. There are 123 junctions in total, while 70 of them are T-sections and the rest are intersections (see Figure 6.K.13). The density of all junctions across the whole area is about 205/km². The density of intersections is 88/km² and the density of T-section is 116/km². No Local streets intersect with other Local streets. Glocal, Local and Internal streets do not intersect with other Internal streets as intersections, but they do connect with each other to form T-sections.

Among all the junctions, there are 36 Glocal-Glocal intersections and 37 Glocal-Internal T-sections. They are the types of intersection and T-section that have the highest numbers. Moreover, the density of Glocal-Internal T-sections (about 62/km²) is the highest among all. It is followed by Glocal-Glocal intersections (60/km²), Global-Glocal intersection (33.3/km²), the Glocal-Local intersection (21.7/km²), Local-Internal T-sections (18.3/km²), and Glocal-Local T-sections (11.7/km²). (see Table 6.K.1). This indicates a very well-connected Glocal street network, and they collect movement from Internal (mostly) and Local streets, and distribute it to the neighbouring Superblocks or to the Global roads.
Table 6.K.1 - Junction Types and Numbers and Street Types of Shijo-Karasuma Superblock

<table>
<thead>
<tr>
<th>Intersection (53) / T-section (70)</th>
<th>Global</th>
<th>Glocal</th>
<th>Local</th>
<th>Internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>4/0</td>
<td>20/2</td>
<td>0/7</td>
<td>-</td>
</tr>
<tr>
<td>Glocal</td>
<td>-</td>
<td>36/2</td>
<td>13/5</td>
<td>0/37</td>
</tr>
<tr>
<td>Local</td>
<td>-</td>
<td>-</td>
<td>0/0</td>
<td>0/11</td>
</tr>
<tr>
<td>Internal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0/6</td>
</tr>
</tbody>
</table>
6.K.2.1.3 Street Patterns:

The general street network is rather regular and evenly distributed making a reasonable well-connected structure. It makes a multi-directional grid across different scales like a fractal repetition with some cul-de-sac and loop pattern in between.

At global level (see Figure 6.K.14.1), the pattern of the Global roads is a relatively regular grid pattern with an average interval of 0.98km. The pattern of the Supergrid is also highly restricted and deformed by the natural geography and train lines. It is denser on the eastern side of the Supergrid that creates Superblocks that are smaller than $1\text{km}^2$, while it is looser on the western side creates Superblocks that are larger than $1\text{km}^2$. Shijo-Karasuma is well-connected to other parts of the city through four long Global roads providing long-distance travel. Moreover, two subway lines and 25 bus lines serve the study site and transport people to other parts of the city through the Global roads (see Figure 6.K.15.1 and 6.K.15.2). It shows that public transportation mainly relies on the Supergrid.

At glocal level (see Figure 6.K.14.2), the pattern of the Glocal streets is similar to the Supergrid at global level forming a grid pattern. The Glocal streets are denser (60m interval) in the neighboring Superblock to the East than the other sides, whereas it gets sparser in the Superblocks to the West. The pattern is much more even within Shijo-Karasuma and on the northern side than within the Superblocks on other sides. The pattern of the street network at glocal level implies a much more even flow of traffic and a very well-connected structure to provide medium distance travel.
At Superblock level (see Figure 6.K.14.3 and 6.K.14.4), the pattern of the network within Shijo-
Karasuma is also a grid with smaller blocks and a denser street network in the southern part. 
A smaller rectangular grid pattern can be also found in this part of the Superblock with higher 
permeability than the northern part. There are many block subdivisions with culs-de-sac, and 
they spread across the whole area with a higher concentration in the north. While Global and 
Glocal streets are mostly in a grid pattern, two Local streets and all Internal streets are in cul-
de-sac or loop form. While Local streets all run in parallel in a north-south direction, Internal 
streets do not provide connections between Glocal and Local streets or between Local streets. 
This means a much connected and permeable network that allows more movements to go in 
the north-south direction. Culs-de-sacs and loops are mostly concentrated in the middle two 
rows of the street blocks and do not interrupt the general grid pattern of the Superblock.

Unlike the street network pattern, one-way or two-way traffic control restricts the flow of the 
cars. As indicated in Figure 6.K.15.3, the result of such traffic regulation is that more cars are 
directed to the Global road on the south edge, and the horizontal Glocal Street in the middle 
(one previous Global Road). On the other hand, the bus lines mainly run along the four Global 
roads and the vertical Glocal street (the other previous Global road) in the middle. While all 
streets are two-way for pedestrian movements (see Figure 6.K.15.4), few lanes provide short 
cuts between the Glocal and Local streets. Most of the short paths gather around the area that 
is between the second and fourth Glocal streets (counting from left to right), which indicates 
more paths for collecting and diffusing traffic into the street blocks along the two street.
Figure 6.K.14.1 - Kyoto Supergrid and Shijo-Karasuma Superblock - Global Scale

Figure 6.K.14.2 - Shijo-Karasuma Superblock and Environs - Supergrid Roads and Glocal Streets pattern - Glocal Scale

Figure 6.K.14 - Kyoto Supergrid and Shijo-Karasuma Superblock - Street Pattern
Figure 6.K.14.3 - Shijo-Karasuma Superblock - The Street Pattern - Local Superblock Scale

Figure 6.K.14.4 - Shijo-Karasuma Superblock - the Pattern of Streets in Grid or Non-grid Form

Figure 6.K.14 - Kyoto Supergrid and Shijo-Karasuma Superblock - Street Pattern
Figure 6.K.15.1 - Shijo-Karasuma Superblock and Environs - Subway and Train Lines and Stations

- Existing Subway Line: 2
- Railway Line: 9
- Subway Station, interval: 800m
- Global Road

Figure 6.K.15.2 - Shijo-Karasuma Superblock and Environs - Bus lines and Stations

- Global Road
- Bus Line
- Bus Stop

Figure 6.K.15 - Shijo-Karasuma Superblock and Environs - Supergrid roads and Movement
Figure 6.K.15.3 - Shijo-Karasuma Superblock and Environs - Car Flow under Traffic Regulation

Figure 6.K.15.4 - Shijo-Karasuma Superblock and Environs - Pedestrian Flow

Figure 6.K.15 - Shijo-Karasuma Superblock and Environs - Supergrid roads and Movement
6.K.2.2 Investigation of Activity

6.K.2.2.1 Distribution of Activities

The distribution of activity in different types is very distributed throughout the whole area in a mix-and-match format (Figure 6.K.16). The most important feature of the Superblock is that buildings with different sizes, types, ages, and functions are all mixed together. This is a perfect example of Jacobs' 'Greenwich Village'. The numbers of consumption, production, service, and residential activities are 412, 427, 355 and 9,781 respectively. Higher buildings are also associated with more functions on different levels (see Figure 6.K.17). The numbers of the mix of consumption and production, consumption and service, production and service activities are 23, 78 and 19 respectively. The number of the mix of all non-residential activities is only 14. The numbers indicate a relatively much-balanced distribution of various activities, while the mix of consumption and production is more common than other types of activity mix.

The distributions of each type of activity and the mixed of them are further indicated in different layers in Figure 6.K.18. Three findings can be found. 1) Single activities are very distributed, whereas the mixed of two or more of them are less distributed and tend to concentrate on the edge and the northeast section. 2) The production and service activities are more dispersed than the consumption activities, which also tend to show a stronger linear concentration along some streets and in the northeast section of the Superblock. 3) The mix between consumption and production activities are more dispersed than the other two mix and the mix of three, which tend to locate along the North and East Global roads. Residential activities are also distributed, but they do not gather around the northeast intersection.
Figure 6.K.16 - Shijo-Karasuma Superblock - Distribution of Activities

Figure 6.K.17 - Shijo-Karasuma Superblock - Street Sections with Dimensions and Functions/Activities
Figure 6.K.18 - Shijo-Karasuma Superblock - The Distribution of Different Functional Use/Activities

- Consumption
- Production
- Service
- Residence
Figure 6.K.18 - Shijo-Karasuma Superblock - The Distribution of Different Functional Use/Activities
**6.K.2.2.2 Variety of Activities:**

The functional activity in this Superblock is highly diverse and also distributed in a mix-and-match fashion (Figure 6.K.19.2), consumption activity includes uses like stores and restaurants are mixed together with banks, hospitals, parking lots, schools and many other uses, rather than being either all stores or restaurants (Figure 6.K.19.1). This means a healthy functioning system that is supported by a mix of different uses to facilitate interactions between different activities to maintain a sustainable diversity in the Superblock. There is a slightly higher concentration of offices and banks in the East section of the Superblock, but in general, it’s all very distributed. Public space is mainly used as parking lots, parks and shrines (Figure 6.K.20). No street vendors or covered shopping streets can be found in this Superblock.

Figure 6.K.21 shows the building uses on different levels. Four key messages can be concluded: 1) There is a huge variety of building uses horizontally and vertically; 2) the building use on the ground level is the most diverse and distributed in comparison to all the other levels; 3) the dispersed pattern decreases as the floor level gets higher, and activities tend to concentrate in the Northeast intersection and along the North and East edges; 4) most commercial uses such as stores and restaurants are concentrated on the first three levels of the buildings, whereas hotels, banks, and offices still exist on the higher levels.
Figure 6.K.19.2 - Shijo-Karasuma Superblock - Distribution of Non-Residential Uses in Buildings

Figure 6.K.20 - Shijo-Karasuma Superblock - Distribution of Uses in Streets
Figure 6.K.21 - Shijo-Karasuma Superblock - Distribution of Uses by Floor
Figure 6.K.21 - Shijo-Karasuma Superblock - Distribution of Uses by Floor
6.K.2.2.3 Intensity of Activities:

The intensity of activity mix is measured according to the ground floor use of each building and the use of each building on different levels, and they are indicated in the Figure 6.K.22 and 6.K.23 respectively. The more mixes of activities there are, the higher the level of activity intensity will become. The first map indicates a very intensive distribution of the functional mix on horizontal level within 50m. The second map, in general, shows a ‘Medium’ level of intensity (mix of one to two types of activities) on the vertical level, and the intensity is slightly higher along the East edge than other parts.

Generally, the horizontal intensity is very high, and the ‘High’ and ‘Very High’ level of intensity is spreading across the whole area. The study site is subdivided into 208 sub-areas, 67.8% of the area within the Superblock contains all four kinds of activities within 50m. 25% (52/208) of the areas are mixes of three types of activity, and 6.25% (13/208) are mixes of two types. This means that the distributed activities can provide more convenience with a mix of different functions, which can sustain the basic needs of people’s everyday life.

Vertically, the general pattern is a very distributed with the single (38%) and mixes of two types (34%) of activities across the site. The high-intensity patches are more dispersed, but most of these are concentrated along the eastern edge, followed by the northern and southern edges. The highest intensity is around the north-east intersection where the major subway station is located.
Figure 6.K.22 - Shijo-Karasuma Superblock - Distribution of Mixed Functions - Horizontal

Figure 6.K.23 - Shijo-Karasuma Superblock - Distribution of Mixed Functions - Vertical

Legend:
- Very High - Mix of Four Functions
- High - Mix of Three Functions
- Moderate - Mix of Two Functions
- Low - One Function
- None
6.K.3 Section Three: Interrelationships
Integration

Connection

Interaction

Photos: By Author
5.K.3.1 Integration

As discussed in the previous chapter, space syntax is again used to understand the space-to-function relationships by analyzing the spatial configuration of the Kyoto Supergrid and Shijo-Karasuma Superblock at four levels: the whole city, the Supergrid (Global scale), the study site and its eight neighboring Superblocks (Glocal scale), and the Superblock (Local scale): these are analysed through global integration (R=n) and/or local integration (R=3).

5.X.3.1.1 Analysis of the City Street Network of Kyoto:

Figure 6.K.24.1 and 6.K.24.2 show the analysis of all the public roads and streets within the area that is served by the Supergrid network by using the global and local integration measures (R=n and R=3) respectively. In general, most streets are in red, orange and yellow color in the two 'synergy maps', which indicate that most streets are well integrated across the whole area. It implies a higher intensity of movement and activities along those streets, and a moderately high level of global-local integration (see Figure 5.X.24.3).

The most integrated streets in the Supergrid are Sanjo, Shijo, Nijo, Karasuma and two Glocal streets in the Shijo-Karasuma Superblock as indicated in red lines. The Global roads locating on the North (Shijo) and East (Karasuma) sides of Shijo-Karasuma Superblock have highest integration values. It suggests that they have a higher movement and activity intensity in the city network.

In the study of Kyoto in 1701 and 1940, Kigawa & Seo (2009) reveals a similar distribution pattern and integration as a strong grid. The Shijo and Karasuma Global roads were also the most integrated into the city network in 1940 (see Figure 5.X.24.3). This proves a city structure that is very stable under the test of time and various developments.
Figure 5.X.24.1 - Kyoto City Road and Street Network - global integration (R=n)

Figure 5.X.24.2 - Kyoto City Road and Street Network - local integration (R=3)

Figure 5.X.24.3 - Global and local Integration Value Scatter Plot
- Global Mean: 1.33
- Local Mean: 2.03
- Connectivity: 4.04

Figure 5.X.24.4 - Kyoto City Roads and Street Network in 1701 and 1940 - Global and Local Space Syntax Analysis (Kigawa & Seo 2009, p.053:5)

Figure 6.K.24 - Space Syntax Analysis - City Network
6.K.3.1.2 Global Integration (the Supergrid):

Figure 6.K.25 shows the analysis of the Supergrid only with global integration (R=n). The results signal a well-integrated Global road network with relatively even distribution of movement and activity in the central area of the Supergrid, and the Global roads become less integrated when they run further out from the central area.

The four Global roads around Shijo-Karasuma Superblock are in red and orange color and they are part of the most integrated roads of the Supergrid. This means that the four Global roads have higher movement and activity intensities than other Global roads in the Supergrid. The ones on the north and west edges are more integrated than the one on the east and south edges. This implies a higher volume of movement along the North and West global road than the other two roads. In the actual observation of the site, this generally matches the flow of automobiles and activity distribution.
Figure 6.K.25 - Shijo-Karasuma Superblock in Glocal Street Network - Global Integration

Global Mean: 0.88
Connectivity: 3.24

Local Integration Re-3

Level of Integration
- High
- Low
6.K.3.1.3 Glocal Integration (between Superblocks)

In the area of nine Superblocks with the Shijo-Karasuma in the middle, the analysis of the Glocal street network by using global and local integration indicates a high level of integration of the street network across scales.

Figure 6.K.26.1 shows the analysis of the Glocal street network with an average value of 1.98. Three Glocal streets are most integrated into the network, and they are all in the study site. The most integrated street is the one on the East side (No.1) of the Superblock with an integration value of 3.3, followed by a global sidewalk street (No.2) and a Glocal Street (No.3) with integration values of 3.11 and 3.07 respectively.

The local integration analysis indicates that most Glocal streets are well-integrated with high integration values. As indicated in Figure 6.K.26.2, most streets are in red and orange color. Three out of five of the most integrated streets are related to the study site, and they have the highest integration values in the Glocal street network of the area of nine Superblocks.

The Scatter plot in Figure 6.K.26.3 also shows a very clear correlation between global and local integration as the data points in the plot almost form a line (see Figure 6.K.26.3). This reveals a very high level of global-local integration, and Shijo-Karasuma has a very well-integrated Glocal street network.
Figure 6.K.26.1 - Shijo Karasuma Superblock - Glocal Street Network - Global Integration

Figure 6.K.26.2 - Shijo Karasuma Superblock - Glocal Street Network - Local Integration

Figure 6.K.26.3 - Global and local Integration Value Scatter Plot

Gobal Mean: 1.98
Local Mean: 2.37
Connectivity: 6.21

Figure 6.K.26 - Shijo-Karasuma Superblock - Street Network (Global and Glocal) Analysis at Glocal Scale
6.K.3.1.4 Local Integration (within the Superblock):

The analysis of the local street network within the Superblock uses local integration (R=3). It includes the analysis of all streets and all streets with multi-level links respectively (e.g. tunnel and bridge). The results show that most Global and Glocal streets are in yellow, orange and red, while Local and Internal streets are in green and blue. This suggests that the former two street types are more integrated than the latter two types, and this is consistent with both maps.

The analysis of all the on ground streets (Figure 6.K.27.1) shows that most Glocal streets have a similar integration value. The southern half of the street network is better integrated than the north half. Two Glocal streets in east-west direction are the two most integrated streets with integration value of 3.64 and 3.55, and the latter is also a local shopping street. In comparison, three Global roads are less integrated except the one on the south edge.

Figure 6.K.27.2 is the analysis of the street network by including the tunnels and bridges. More streets are in orange and red color, and most Glocal streets are still very well integrated. It also indicates an increase of the integration value of all streets in the local street network. The Global roads on the east and north edges change from yellow to orange with an increase of integration value. The Global road on the southern edge becomes the most integrated street.

In general, the analysis of the Glocal street network indicates a very well-integrated network with relatively even distribution of movement and activities. Global and Glocal streets have very similar integration values and they are much more integrated than Local and Internal streets. This pattern roughly matches the finding as indicated in the functional distribution map.
Figure 6.K.27.1 - Shijo-Karasuma Superblock Street Network - Local Integration

Local Mean: 1.93
Connectivity: 3.36

Figure 6.K.27.2 - Shijo-Karasuma Superblock Street Network with multilevel links - Local Integration

Local Mean: 1.98
Connectivity: 3.27

Figure 6.K.27 - Shijo-Karasuma Superblock - Local Superblock Integration Analysis
6.K.3.2 Connection:

6.K.3.2.1 Street Patterns and Activity Types:

While most activity types are well distributed across the site, there are still some traceable relationships between activities and street patterns as indicated in Figure 6.K.28.

The percentage of consumption, production and service activities locating along the grid takes up to 94.4%. Only 1.9% is located next to cul-de-sacs, and less than 1% is related to loops. This indicates that most non-residential activities favor the grid that is formed by the Global, Glocal and Local streets, rather than the cul-de-sac or loop pattern. In other words, the grid pattern is responsible for creating such a dispersed distribution of activities as discussed before. The residential activities are absent in the two street blocks on the north-east corner and where schools locate, and they show no clear relationships to any street patterns.

According to Hillier, Alexander and Marshall’s theory, this finding reflects the theory about the grid network that is formed by a semi-lattice way of thinking has higher connectivity than other street types and it can generate more activities through movement that runs in the network.
Figure 6.K.28 - Shijo-Karasuma Superblock - Connection between Street Patterns and Distribution of Generic Functions (Consumption, Production, Service and Residence)
6.K.3.2.2 Street Types and Activity Types:

The connections between types of street and activity are indicated in Figure 6.K.29. The distribution of activities spreads fairly evenly along the Global roads and Glocal streets. More production activities gather along the Glocal streets than the other two street types. In comparison, consumption activities are rarely found on Local and Internal streets.

The numbers of consumption, production and service activities along each type of street are indicated below each map on the next page. By regarding each street type as one network, the numbers indicate that most non-residential activities are related to the Glocal street network. 63.8% of consumption activities locate on the Glocal streets. In comparison, 64.8% of production and 57.6% of service activities are located along the Global streets. Moreover, three measures of activity density associated with each street type are indicated in Figure 6.K.29.Table.

<table>
<thead>
<tr>
<th></th>
<th>Global Roads</th>
<th>Glocal Streets</th>
<th>Local Streets</th>
<th>Internal Streets</th>
</tr>
</thead>
<tbody>
<tr>
<td>per street</td>
<td>85</td>
<td>104</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>per km street</td>
<td>110</td>
<td>141</td>
<td>101</td>
<td>32</td>
</tr>
<tr>
<td>per street density</td>
<td>66</td>
<td>85</td>
<td>60</td>
<td>23</td>
</tr>
</tbody>
</table>

Those numbers indicate three major findings. Firstly, the non-residential activities are mostly located on Glocal streets rather than the other street types. Secondly, the Glocal Street network has the highest activity density, while Internal streets have the least. Thirdly, production activities have the strongest relationship to the Glocal Street network than all the other types. Internal streets are mostly associated with residential activities.
Figure 6.K.29 - Shijo-Karasuma Superblock - Connection between Street Types and Distribution of Generic Functions (Consumption, Production, Service and Residence)
6.K.3.2.3 Street Types and Building Uses:

More specifically, there are some clear patterns that correlate different types of streets with some specific uses of buildings. While most are distributed with no clear patterns, several patterns can still be found (see Figure 6.K.30):

1) 91.4% of shops and restaurants (384/420) are located along Global roads and Glocal streets and 58% of these are located along Global roads and streets.

2) All convenient stores are located along Global and Glocal streets with 75% (12) occurring at the corner of Global-Glocal and Glocal-Glocal intersections.

3) Gas stations are always located on either Global roads or Glocal streets. The favored location is the intersection between a Global road and major Glocal street.

4) 87.5% of hospitals and clinics can be found along global and Glocal streets. Of these, 70% are located along Glocal streets.

5) 80% (12/15) of educational institutions are located along Global roads and Glocal streets.

6) 62.5% (87/136) of parking lots are located along Glocal streets.

7) 93% of banks are located on the Global roads, indicating a stronger relationship to long distance travels and city wide connections.

8) 40% of hotels are related to Glocal streets, and 35% of these are related to Global roads. This means 75% of hotels have a stronger relationship to Global and Glocal streets.

9) Shrines and temples occur most frequently (70.6%) along the Glocal street (not including Global sidewalk streets).
Figure 6.K.30 - Shijo Karasuma Superblock - Connection between Street Types and Building Uses
6.K.3.2.4 Street Densities and Activities Types:

Figure 6.K.31 indicates the relationship between street junctions types and activity types, and the results show that no clear relationships between the two can be found.

However, over 70% consumption activity shows a clear relationship to junctions, especially intersections. Of these, most are also located around Global-Glocal and Glocal-Glocal intersections. This is similar to Jacobs’ argument about more frequent streets and more intersections are the nurturing soil for more and diverse activities. Nevertheless, this is only a valid statement for consumption activity in this Superblock.

On the other hand, production and service activities do not show any relationships to intersections or T-sections, and most are very dispersed across the site. It indicates that higher street density is more related to consumption activities rather than production, service or residential activities.
Figure 6.K.31 - Shijo-Karasuma Superblock - Connection between Street Junctions and Generic Functions
6.K.3.3 Interaction

6.K.3.3.1 Street Types and Activity Mix:

The interaction between streets and activities can be seen from the distribution of the ‘mix of mix’ of different activities on site. By superimposing maps of the activity mix with the street network, it reveals some spatial relationship between the two.

Figure 6.K.32 shows different non-residential activity mixes and street types within the Superblock, and it generally illustrates a dispersed distribution. More specifically, the mix of consumption and production activities (23) is the most distributed, whereas the mix of consumption and service activities (78) and the mix of production and service activities (19) have stronger relationships to the East and North Global roads and some Glocal streets than other street types. More mix of all three types can be found along Glocal streets than Global roads. Very few of the mixes concentrate along Local streets, and no mix of activities can be found along Internal streets.

In other words, such distribution indicates the structural importance of Global and Glocal streets, especially the North and East Global roads. The mix of consumption and production activities can mostly be found along the Glocal streets. The mix of production and service, consumption and service and the mix of all three types of activities can mostly be found along the Global roads. Local and Internal streets are not suitable for creating any type of mix, except the mix of consumption and production activities.
Figure 6.K.32 - Shijo-Karasuma Superblock - Interaction between Street Network and Functional Mix

Consumption + Service Mix

- Global: 19
- Local: 15
- Total: 78

Production + Service Mix

- Global: 10
- Local: 2
- Internal: 0
- Total: 19

Production + Consumption Mix

- Global: 12
- Local: 1
- Internal: 0
- Total: 23

Mix of Three Types

- Global: 5
- Local: 0
- Internal: 0
- Total: 10
6.K.3.3.2 Street Types and Building Use Mix:

More specifically, while most of the mixes of building uses are very distributed with no clear relationships to any specific street type, several patterns can still be found as indicated in Figure 6.K.33.

The first group of maps indicates how hospitals, schools from service type and shops, restaurants, convenience stores from consumption type are mixed together. The result shows a clear relationship between consumption and service activities. 93% of the schools are mixed with shops and restaurants. 89% of hospitals or clinics are mixed with shops and restaurants.

The second group of maps indicates how hotels from service type and restaurants from consumption type are mixed together. Because Shijo-Karasuma is located in the central part of the city and next to a famous tourist market, there are a lot of hotels in this Superblock and they show a clear relationship (55%, 11/20) to restaurants.

The third group of two maps indicates how factories from production activities mix with parking and logistics from service activities and convenience stores from consumption activities. It is to show where workers from factories park their cars, transfer goods and buy food or get money from convenience stores. The result indicates a stronger mix between the parking, logistics, and factories: 73.1% of factories are located next to a parking lot and 75% of logistics are located next to a factory.

The fourth pair of maps indicates how offices and factories from production activities, shops and convenience stores from consumption activities mix with banks from service activities. It is to show where office and factory workers can buy food, manage finance and go shopping after work. The result shows a stronger relationship between shops, offices, and factories, and the mix of the three is mostly concentrated along the North and East Global roads.
Figure 6.K.33 - Shijo-Karasuma Superblock - Interaction between Street Network and Building Uses
6.K.3.3.3 Street Density (Junctions) and Activity Mix:

The interaction between activity mix and junction types is indicated in Figure 6.K.34. Among them, the mix of consumption and production activities indicates a strong relationship (76%) to intersections. Of these, nearly half (44%) are specifically related to Global-Glocal intersections. 80% of the consumption and service activity mix is around intersections, and most (75%) are also located around Global-Glocal intersections. Similarly, 80% of the production and service activity mix is also around intersections, and 87.5% of these are also around Global-Glocal intersections.

The results suggest that the mixes of three types of activities are mostly located around intersections, especially Global-Glocal intersections. It implies a strategic spatial importance of the Global and Glocal intersections in a street network.
Figure 6.K.34 - Interaction between Street Junctions and Functional Mix
6.K.3.3.3 Street Types and Activities Intensity:

The interaction between the intensity of activity mix and street types indicates two general findings: 1) the intensity of activity mix on horizontal level is much higher than the intensity on vertical level; 2) there is a clear relationship between the high intensity and Global roads on the vertical, and between high intensity and Glocal streets on the horizontal level.

Figure 6.K.31.1 indicates how the intensity of activity mix is related to different streets types on the horizontal level. In general, the intensity is very high across the whole site. More than 90% of the area in Shijo-Karasuma is served with more than three types of activities. Most of the areas with 'High' intensity are related to Glocal streets. 92.6% of the intersections are related to the areas with 'Very High' intensity (the mix of four types of activities), and most T-sections show a strong relationship with the 'High' intensity areas (the mix of three types of activities).

Figure 6.O.31.2 indicates the intensity of activity mix in relation to different street types on the vertical level. The results show that the vertical intensity is generally moderate. 68% of the high intensity (mix of three and four types) is located on the Global roads. Of these, 33% is located around the corner of intersections or T-sections. This indicates a stronger relationship between activity mix and Global roads, but no clear relationship between junctions and intensity of activity mix can be found.
6.K.35.1 - The Mapping of the Intensity on Horizontal Level

6.K.35.2 - The Mapping of the Intensity on Vertical Level

Figure 6.K.35 - Shijo-Karasuma Superblock - Interaction between Street Network and Activity Intensity
6.K.4 Section Four: Discussion of Findings

The investigation of the Shijo-Karasuma Superblock shows some clear relationships between the street network and the distribution of activities. It is also evident that culture plays an important role in shaping the physical form but in a subtle manner. The structure of Shijo-Karasuma persists consistently as a grid pattern, which allows for multidirectional movement at multiple scales to generate evenly distributed activities across the whole site.

The analysis of street types, density and pattern reveal the importance of Glocal streets as a grid network. While the street network, in general, shows high levels of connectivity with four street types linking effectively as a grid network, it is the Glocal streets that are evenly distributed with the highest density construct the major skeleton for this Superblock. Local streets intensify the grid and give the opportunity for further subdivision of the Superblock. Internal streets, in loop and cul-de-sac patterns, are usually contained within street blocks and show little impacts to the Glocal grid. Because Local and Internal streets are mostly connected to Glocal streets, most traffic is fed to the Glocal streets, which can carry movement into the neighboring Superblocks.

Activities appear to be very well distributed across the whole Superblock area. Production activities take the highest percentage (40% of the total) of all types, and consumption (31%) and service (29%) activities are about the same. However, production activities show the least variety, while service activities exhibit the most. High concentrations of activity mix exist across much of the Superblock in a horizontal fashion (that is at ground level) but this does not extend significantly to higher floors. Non-residential activities and limited activity mixes are found at higher levels mostly around the edges of the Superblock, especially along the North and East edges.

Integration analysis of the Shijo-Karasuma Superblock shows a well-integrated street network structure across local, glocal and global scales, and it is exceptionally good at Glocal scale. The results imply a reasonably even distribution of movement and mixed activities in Shijo-Karasuma, and this roughly matches the activity distribution as mapped. All Glocal streets and
most Local streets are well-integrated across scales, and some Glocal streets are more integrated than Global roads. Internal streets are the least integrated, and it implies the lowest movement and activity intensity as suggested by the theory. By including the multi-level links into the analysis, the result is closer to the actual activity distribution than the conventional analysis of only taking the streets on the ground level into consideration. The only discrepancy is that the East and North Global roads are supposed to have higher activity intensity than the analysis predicted. This may be explained by the two subway stations on the northeast and southeast intersections, which attract extra activities along the East and North Global roads.

The analysis of Connection indicates that the relationship between Glocal streets and non-residential activities is the strongest of all types. They have the highest concentration of activities (especially consumption and production types), and also the highest activity density. They are followed by Global roads, which show a slightly weaker but still clear relationship to non-residential activities. Local streets show a stronger relationship to production than consumption activities. Intersections rather than other junction types are invariably associated with more relationship to non-residential activities. Consumption activities show a particularly strong presence around junctions, especially Global-Glocal intersections. In other words, this structure is mostly supported by the Glocal streets that create an accessible street network that allows the different activities to locate in close proximity.

The analysis of Interaction shows the importance of Global roads, which are clearly associated with slightly more activity mix than the other street types. The mix of consumption and production and the mix of production and service activities both show the strongest relationship to Global Roads. However, the mix of service and consumption activities indicates a clear relationship to Glocal streets. The results also emphasize the relationship between activities and Global-Glocal junctions. Such locations provide distinct structural advantages to attract more activities and more diversity and so generate interaction and synergies. As a result of such a structure, the intensity of the mix on horizontal level indicates a very convenient living environment. Most areas in the Superblock are served with all four types of activities within 50m. Vertically, higher intensity tends to gather along the Global roads, emphasizing the importance of Global connection for a mix of activities to gather.
Imazato, Osaka
今里，大阪
Figure 6.0.1 - Imazato Superblock in the Osaka Supergrid - Global Scale
(Adapted from Google Map by Author)

The Study Site

The Supergrid
6.0 Supergrid and Superblock Structure in Osaka

The city of Osaksa is about 223 km$^2$ with almost 3 million population. The highly urbanized area is about 150km$^2$ (15X10km), and it is covered by a Supergrid and Superblock structure as indicated in Figure 6.0.1. The Supergrid is quite regular in the middle area, although broken occasionally around major transportation centers that are responsible for some irregular shapes in between regular Superblocks. The street interval of the Supergrid varies, and it generally forms two sizes of Superblock: the small and regular ones (500 X 500m) in the middle commercial area and large but irregular ones (1km X 1km) in the outer part of the Supergrid. The selected Superblock is towards the northern periphery of the whole system, which gives it an edge condition and a relatively larger size than those in the middle area (see Figure 6.0.2). It is also selected as the second type of Superblock as indicated in the Methodology Chapter.

The size of the Imazato Superblock is about 1.56km$^2$ and roughly square in shape (see Figure 6.0.3). The total built area of Imazato is about 0.96km$^2$ with a building coverage of 61.5%. The average floor area ratio (FAR) is about 0.92 on average, and the population density is between 150 and 299 people/ha, and 249 people/ha on average as indicated in Figures 6.0.3.1 and 6.0.3.2. It is a major residential area with some industrial functions (Osaka City Planning Division 2015).

Figure 6.0.3.1 - A Map of Population Density Distribution in Osaka City 2000 (Osaka City Planning Division 2015)
Figure 6.0.3.2 - A Map of Floor Area Ratio Distribution in Osaka City 2001 (Osaka City Planning Division 2015)
The Study Site

The Supergrid

Figure 6.0.2 - Imazato Superblock in its Supergrid environs - Glocal Scale
(Adapted from Google Map by Author)

Figure 6.0.3 - Imazato Superblock - Local Scale
(Adapted from Google Map by Author)
6.0.1 Section One: Cultural Influence

6.0.1.1 The Cultural Influence on the Formation of the Imazato Superblock

Figure 6.0.4 illustrates the built form of Imazato Superblock. It contains 9,651 individual buildings with average site coverage and FAR of 52% and 0.92 respectively. It indicates a densely structured fine grain and texture, which has been formed in a series of historical transformations that are influenced by the Floor-oriented Areal spatial conception of Japanese culture, as discussed in Chapter Two. Using Lerup 1976’s classification of building types, the most pervasive type of building in this Superblock are the pavilions and row houses. They are usually two to three story high and 3 to 6m wide. No perimeter block is found.

Three important conditions can be observed:

1) A ‘hard shell-soft yolk’ form can be seen in this Superblock. Although the hard shell is weaker along the East and South edges where there are fewer tall buildings to form a shell, it is stronger on the North and East edges. Both the new and old settlements together formulate a ‘soft yolk’ (mostly low and small buildings), which vividly indicates the ‘two-dimensionality’ of Japanese spatial culture in the settlement expansion.

2) Buildings of different sizes, ages, forms and functions are all mixed together and arranged in two contrasting spatial orders: the organic and irregular arrangement in the south-west quarter (the red area in the figure), and a regular type of modern grid arrangement in the other three quarters. This results two different grain sizes and two types of Group Form: the smaller buildings with finer grain size in the former and the bigger buildings with coarser texture in the latter area.

3) The irregular area displays the quality of Maki’s ‘Oku’ concept of Japanese space with depth, while the regular area is derived from modern Western planning.
The Old Village Area

Temples and shrines will usually take a traditional form and sit behind walls.

Traditional style shop houses that stand collectively in groups.

Buildings that have larger footprints are factories, schools or large company buildings, though these are generally no more than 4 stories high.

Pavilions are mixed with towers and with buildings of a large footprint. Towers often incorporate a slope plane or a large setback because of the limitation of narrow streets.

Figure 6.0.4 - Imazato Superblock - 3D Model (Top) and Figure Ground (Bottom)
6.0.1.2 The Formation of the Modern Supergrid and Areal Thinking

The Supergrid did not exist in the early settlement of Osaka, but there was a network of water channels. The construction of these waterways separates the city into a number of areas that commenced in the 17th century (see Figures 6.0.5.1, 6.0.5.2 and 6.0.5.3). The areas are large enough to contain street blocks and may be considered as a form of water Superblock: the water channels were the equivalent of a Supergrid system, with areas of small streets within, creating a multi-directional movement network for boats.

This structure was kept until the more recent modernization of the city in the early 20th century. A network of tram lines was constructed in order to accommodate the new type of public transportation service as a Supergrid of wide roads (see Figures 6.0.5.2, 6.0.5.3, 6.0.5.4, 6.0.5.5 and 6.0.5.6). As a consequence, the tram network as a Supergrid divided the city into a number of areas that may also be considered as Superblocks and set the skeleton of the modern Supergrid. This has been gradually converted into a network of wide roads for automobiles since the 1960s. Some water channels were also filled and converted to wide Global roads, which changed the sizes and shapes of the Superblocks in the commercial areas of the city.

During this transformation, while a Supergrid was not always implemented, a street block structure has been used consistently. Thus, space has been written in the form of street blocks in two major sizes: 80X80m and 120X120m. At the same time, taking in different technologies, as networks of water channels, tram lines or roads, the Supergrid and Superblock structure has persisted. These characteristics indicate that there has been a tendency to think ‘Areally’ and a multi-directional structure has been influencing the development of this city.
Figure 6.O.5.1 - The Modern Supergrid Network and Three major Networks that is related to Supergrid and Superblock Structure

Figure 6.O.5.2 - Ancient Naniwa: The City of Osaka in 1691

Figure 6.O.5.3 - The City of Osaka and its River Channel System in 1885

Figure 6.O.5.4 - The City of Osaka and the Tram Network Layout in 1928

Figure 6.O.5.5 - The City of Osaka and the Tram Network Layout in 1955

Figure 6.O.5.6 - The Mock Painting Picture of the City of Osaka in 1924

(International Research Center for Japanese Studies 2016b)

Figure 6.0.5 - Kyoto Supergrid History – Structural Transformation

(All Maps are from the International Research Center for Japanese Studies 2016b)
**6.0.1.3 Historical Transformation: Floor-oriented Spatial Conception**

Imazato Superblock was in the Higashinari Country, which was previously a rural area with several villages on the north side of the Osaka City. The area was not part of the City until 1925 when the city boundary was extended to this area. It then became the Higashinari District of Osaka City. As indicated in Figure 6.0.5.1, the Global road on the South edge of Imazato Superblock was firstly formed in the 1920s, and the Global roads on the West, North and East edges were constructed successively later. In other words, Imazato was gradually formed during the 1920s to 50s with the process of road widening, land readjustment and extension of the tram network, which was later used as the Global road network for automobiles.

Four major stages of transformation of the Imazato Superblock can be summarized and they are indicated in Figure 6.0.6.2. The first stage of formation was at the end of 19th century when this was only a rural area with a few small villages. Each village contained a network of meandering streets that possessed an oku type of space and organic spatial organization. The second stage occurred after this area was merged into Osaka City. The irregular block and organic street patterns in the villages were inherited, expanded and merged into the bigger modern urban settlement but were still irregular in form until the 1920s. The third stage of development shows a re-organization of the spatial order into a combination of regular and irregular street blocks. The organic structure was kept in the land readjustment development of this area in the 1930s and 40s. To a large extent, the regular streets network was expanded from the old village areas as starting points and emerged with the organic streets as one connected grid network. The final stage of the transformation occurred in the early 1950s. With the waterway being fully constructed, the street blocks were further extended north and west and later bounded by the two Global roads.

In this process, the modern regular grid expanded around the irregular grid in all directions, creating an ‘Oku’ type of spatial structure along with a built form that has a clear 'two-dimensionality'. Moreover, there are also no clear boundaries between the old and new settlements, which are agglomerated together seamlessly through the expansion of street with depths. Those characteristics clearly reflect an 'Areal' thinking with a strong floor orientation.
Stage One: The Imazato Superblock in 1885 showing the early three villages in this area

Stage Two: The Imazato Superblock in 1929 showing the coercion with imposition

Stage Three: The Imazato Superblock from 1930s to 1940s showing grids around village

Stage Four: The Imazato Superblock from 1950s to 1970s showing grids around village

Figure 6.0.6.1 - Imazato Superblock - Construction Dates of Global Roads

Figure 6.0.6.2 - Imazato Superblock - Historical Transformation
(Drawings are made by Author based on: International Research Center for Japanese Studies 2016b, Osaka City Urban Housing History Editorial Committee, 1989 and Osaka City's Ward Organization 1995)
6.0.2 Section Two: General Morphology

Figure 6.0.7 indicates the block and street structure of Imazato Superblock. It shows two clear contrasting patterns: numerous organic streets that are densely packed together forming a irregular grid that is on the site of the old village area in the southwest quarter, and the rest streets forming a regular grid across the other three quarters resulted from recent modern development. Similarly, the block structure also presents two contrasting shapes: the irregular blocks in the old village area (mostly the yellow and blue areas); and larger blocks over the remaining area (mostly the orange and red). The street blocks are mostly very small with sizes ranging from as small as 12X8m to as large as 142X120m (see Figure 6.0.8). most of the regular blocks are oriented in the east-west direction in the non-village area, whereas most irregular blocks tend to stretch in a north-south direction. The exceptions are the street blocks along the edges that tend to be regular and have their longer side to the Global roads.

Moreover, the blocks in the non-village area are equipped with sidewalks, while the blocks in the village area are not, and this clearly shows a invisible boundary between the old village area and the non-village area (roughly around the yellow dotted line in Figure 6.0.7). This indicates two principles of designing block structure, resulting in two different street structures that are united in one network to accommodate two types of street blocks in a harmonious state by using the street depth as a tool. It further resonates the floor-oriented spatial conception as discussed in Chapter Two.
Figure 6.0.7 - Shijo-Karasuma Superblock - The Streets and Blocks

Figure 6.0.8 - Shijo-Karasuma Superblock - Block Sizes
6.0.2.1 Investigation of the Street Network:

6.0.2.1.1 Street Types:

The four types of streets are indicated in Figures 6.0.9 and 6.0.11. These streets are structured to form a hierarchical network that further affects the height and form of buildings since these are determined in part by the street width-related slope plane rule. (see street section examples in Figure 6.0.10). Separating Imazato into east and west sections, the river channel does not obstruct the connectivity between the two sections by having 11 bridges to link them.

Four Global roads are flanked with 5m wide sidewalks on average. The widths of three Global roads are about 25m with four car lanes. The other one on the North edge is much wider at around 40m with eight car lanes and an elevated highway. Also, three subway lines providing city-wide travel run underneath the North, South and East Global roads. Buildings tend to be higher at the edges, especially along the North Global road. However, these are occasionally interspersed with lower buildings to form a 'broken shell'.

26 Glocal streets are in the widths between 2 to 10m, and most are designed as shared space. Some have light-controlled crossings to provide connection between neighboring Superblocks while others are connected by bridges and tunnels. Their narrow widths result generally in lower building heights along their sides, but some higher buildings can also be found where lots are larger and allow for greater setbacks or slanted forms.

25 Local streets range between 2 to 8m in width and between 40 to 1,280m in length. Most of them are shared space, but some have sidewalks, especially those along the river, which are designed with clear delineation between pedestrians and cars. In comparison, 437 Internal streets are all designed as shared space. Both Local and Internal streets tend to be narrower in the village area with lower buildings (less than 5 stories). The two types also tend to be wider with higher buildings in the non-village area (up to 30-storey or with slanted roof). Some tall buildings can go up to 30 stories internally, especially along the Local streets next to the river.
Figure 6.0.9 - Imazato Superblock - Street Network and Types

- Local Street
- Global Road
- Glocal Street
- Internal Street
- Subway Station (under construction)
- Crossing

Section O - 1

Section O - 2

Section O - 3

Section O - 4

Figure 6.0.10 - Imazato Superblock - Road/Street Types in Sections

- Slope Plane
- Restriction of Building Height

Section O - 1

Section O - 2

Section O - 3

Section O - 4
Figure 6.0.11.1- Global Roads

Figure 6.0.11.2- Glocal Streets

Figure 6.0.11- Imazato Superblock - The Four Street Types
6.0.3.2. Street Densities (and Dimensions):

Figure 6.K.12 indicates the numbers, widths, lengths, and densities of Global, Glocal, Local and Internal streets. The total length of all streets within Imazato is 56.89km with a density of 36.5 km/km$^2$, and the density of each street type is 3.2, 13.53, 7.15 and 39.47 km/km$^2$ respectively. The numbers of each street type in proportion to the total number of streets are 0.008, 0.053, 0.051, 0.89, which show a positive correlation to their densities in this Superblock.

Among the four types, Internal streets are the most numerous (437) and have the highest density in the Superblock (61.57km), but they are usually very short (0.14km on average) and narrow (3.9m on average). They are followed by Glocal streets, Local Streets and Global roads. The length and density of Internal Streets are also much higher than the total length and density of the sum of the other three types of streets. In other words, Imazato Superblock has an extremely extensive internal street network that provides channels for short distance travel.

The Glocal Street is the second most predominant type with an average length of 0.76km within Imazato. Local streets are almost as many as the Glocal streets, and they are variable in length (from 0.04km to 1.28km) with an average length of 0.45km. Because the Internal streets are all either attached to Local or Glocal streets in the network, movement from Internal streets usually flow through Local streets to reach the Global roads for long distance travel, or run through Glocal streets to go into the neighboring Superblocks for medium distance travel. This suggests two types of connection: the Glocal-Internal and Local-Internal. However, judging by their numbers, densities, average length and widths, the former obviously is a more prominent type of connection in this Superblock.

Street width still shows a huge disparity between the wide Global roads and narrow Internal streets. Glocal streets show a very similar width to the Global sidewalk streets, and it implies that they are part of the same network in the spatial structure.
Figure 6.0.12 - Imazato Superblock - Key Dimensions of the Four Street Types

Street Density

Number of Streets

Average Street Length

Average Street Width

Figure 6.0.12 - Imazato Superblock - Key Dimensions of the Four Street Types
It follows from the above information that the intensity of those junctions is much higher in the old village area than in the non-village area as indicated in Figure 6.0.13. However, the distribution of the junctions is more even in the non-village area than in the village area.

The number of each junction type is indicated in Table 6.0.2. There are 912 junctions in total, including 262 intersections and 650 T-sections. Those numbers imply a junction density across the whole area at about 608/km² with the density of 175/km² for intersections and of 433/km² for T-sections. Intersections are normally formed by Global-Glocal streets, Glocal-Glocal streets or Glocal-Local and Local-Local streets. T-sections are always created when an Internal street connects to a Glocal or Local street. This reveals the Global, Glocal and Local streets are mostly structured as a grid.

The number of T-sections is more than twice that of intersections, which is consistent with the highest number of Internal streets. Internal-Internal connections account for 265 T-sections indicating the highest density of 176/km² among all T-section types. It is followed by Glocal-Internal (114/km²) and Local-Internal T-sections (90/km²). There are also 63 Glocal-Internal intersections with the highest density of 42/km² among all types of intersections, followed by Glocal-Glocal and Glocal-Local intersections. This indicates that the Glocal streets are very well connected to each other and to Internal streets, creating a network that gives very convenient connections between Imazato’s Internal streets and neighboring Superblocks.
Intersection (262) / T-section (650)

<table>
<thead>
<tr>
<th></th>
<th>Global</th>
<th>Glocal</th>
<th>Local</th>
<th>Internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>4/0</td>
<td>28/5</td>
<td>0/26</td>
<td></td>
</tr>
<tr>
<td>Glocal</td>
<td>-</td>
<td>55/10</td>
<td>48/33</td>
<td>63/171</td>
</tr>
<tr>
<td>Local</td>
<td>-</td>
<td>-</td>
<td>10/5</td>
<td>27/135</td>
</tr>
<tr>
<td>Internal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27/265</td>
</tr>
</tbody>
</table>

Table 6.0.2 - Junctions Types and Numbers and Street Types of Imazato Superblock
6.0.2.1.3 Street Patterns:

The pattern of the street network forms a multi-directional Supergrid on the Global scale, and the pattern is a combination of grids, cul-de-sacs, and loops on Glocal and local (Superblock) scale. According to Alexander and Marshall’s studies, the grid and cul-de-sac street networks are essentially semi-lattice and tree in nature, and they can facilitate and impede connectivity for movement respectively. For this study site, the street network is ‘semi-lattice’ with a good connection at the global scale, but it becomes a mix of ‘semi-lattice’ and ‘tree’ with theoretically a mix of good and poor connectivity at the Glocal and local scale.

The Global roads are structured as an uneven grid pattern with an average interval of 1.2km. In the denser inner urban areas, Superblocks are about 0.5 km square, whereas they are often larger and less regular in the outer areas with some Superblocks exceeding 1km², including Imazato (see Figure 6.0.14.1). Some radial patterns can be found to deform the Supergrid and are formed mostly around a few major transportation (station) nodes. One of the radial patterns is at the southwest intersection of the Imazato Superblock. With such street pattern, three subway lines aligned with the South, North and West Global roads (see Figure 6.0.15.1) and 6 bus lines operate along the North, West and East Global roads and one Glocal street in the middle (see Figure 6.0.15.2) serve Imazato Superblock together. The former provides multi-level city-wide connections in all four directions and connect to railway lines. The latter provides connections between the major train stations, schools, and several commercial areas, where there are higher concentrations of people. The public transport system implies that this Superblock offers a relatively convenient connection to other part of the city mainly through the Global roads.

At Glocal level, there are 9 crossings on the North, East and West sides and 10 on the South side to link Imazato with its neighboring Superblocks and areas giving an average interval between crossings of 139m. This means that Global roads are not barriers between Superblocks. Moreover, the pattern of the Glocal streets is different to the grid pattern at the global level (see Figure 6.0.14.2). It is unevenly
distributed with a combination of dense and well-connected irregular grids in the western, southern and eastern areas. In the other neighbouring areas (north, northeast, and northwest), Glocal streets are structured to form unevenly distributed grid networks. Moreover, there is a clear disconnection to the three Superblocks in the south part of the Osaka Castle, where much loose Glocal street networks exist. The pattern of the street network at Glocal level shows a mix of a well-connected and poorly connected network. It implies an uneven distribution of traffic for medium-distance travel.

At local scale, Imazato Superblock has a street network that is fairly dense across the whole area (see Figure 6.0.14.3). Furthermore, Imazato presents two contrasting street patterns corresponding to the two types of blocks: the grid pattern associated with the regular blocks in the non-village area; and the denser organic, sometimes curvilinear, irregular pattern that responds to natural contours and exhibits greater depths, in the old village area to give an Oku-like quality (Figure 6.0.14.4). This irregular street pattern is similar to that found by Shelton (2012) in the Gokiso Superblock in Nagoya (p.156-157), where there was also an old village. Despite the irregularity, the network is mostly a grid rather than a tree structure in the village area, while many Internal streets are actually cul-de-sacs in the non-village area. Moreover, most Internal streets run east-west direction in the non-village area, but north-south in the village area. This creates two different patterns that are linked by Glocal and Local streets and forms two kinds of streetscape within Imazato.

Streets are used two-way for walking and cycling with the shopping street (in thicker red line) having the highest volume (see Figure 6.0.15.4). The pedestrian flow also goes underground at the four subway stations and overground at the two bridges creating some multi-level movement. However, the network does not always indicate car flows accurately. Many streets are not accessible for cars because of their narrowness and others are one-way for traffic control. All the Global roads, 12 Glocal roads and many Internal streets are two-ways, but 14 Glocal and 17 local streets are one-way only (see Figure 6.0.15.3). As a result of the regulation, traffic is directed relatively evenly in all four directions to the neighboring Superblocks or Global roads.
Figure 6.0.14.1 - Osaka Supergrid and Imazato Superblock - Global Scale

Figure 6.0.14.2 - Imazato Superblock and Environs - Supergrid roads and Glocal Street Pattern

Figure 6.0.14 - Osaka Supergrid and Imazato Superblock - Street Pattern
Figure 6.0.14.3 - Imazato Superblock - The Street Pattern - Local Superblock Scale

Figure 6.0.14.4 - Imazato Superblock - the Pattern of Streets

Figure 6.0.14 - Osaka Supergrid and Imazato Superblock - Street Pattern
- Total Bus Line: 118
- Bus Line serve Imazato: 6
- Stop Interval: 200-400m
- Location: close to schools and shopping area that have a higher concentration of people

Figure 6.0.15.1 - Osaka Supergrid and Imazato Superblock - Subway Lines and Stations

Figure 6.0.15.2 - Osaka Supergrid and Jinyuan Superblock - Bus lines and Stations

Figure 6.0.15 - Imazato Superblock and Environs - Supergrid roads and Movement
Figure 6.O.15 - Imazato Superblock and Environs - Car Flow under Traffic Regulation

Figure 5.N.15.4 - Imazato Superblock and Environs - Pedestrian Flow + Public Transport

Figure 6.O.15 - Imazato Superblock and Environs - Supergrid roads and Movement
6.0.2.2 Investigation of Activity

6.0.2.2.1 Distribution of Activities

The distribution of the four types of activities is indicated in Figure 6.0.16 and 6.0.18. The numbers of consumption, production, service and residential activities are 878, 1,782, 1,050 and 37,554 respectively. The numbers of the co-existence of consumption and production, consumption and service, production and service type of activities in the same building are 16, 15 and 3. Only one building houses all three types of non-residential functions.

Three major findings can be concluded. 1) All types of activities are generally very well distributed across the Superblock. However, the distribution is a little bit different in the village and non-village area. Consumption and service activities are more prominent in the former area, whereas the non-village area has more production activities; 2) each type of activity is distributed in a slightly different fashion. Consumption activities are distributed but also tend to gather in a linear format as shopping streets. Service activities are more distributed than consumption activities with no clear concentration. Production activities are also distributed, but most are dispersed in the non-village quarters. Residential activities are just everywhere, but a few street blocks noticeably devoid or almost devoid of a residential component in the regular grid area. The size of establishments varies with larger operations in the regular blocks of the north and east and smaller ones in the irregular old village area; 3) the distribution of activity mix is rather limited in Imazato and they mostly concentrate along the Superblock's edges. Most of these are the mix of consumption and service type, while production-consumption and production-service mix have minor presences (see figure 6.K.17).
Figure 6.0.16 - Imazato Superblock - Distribution of Four Major Functions

Figure 6.0.17 - Imazato Superblock - Street Sections with Activities on Different Levels
Figure 6.0.18 - Imazato Superblock - The Distribution of Activities and Mix
Figure 6.0.18 - Imazato Superblock - The Distribution of Activities and Mix
6.0.2.2.2 Variety of Activities:

Figure 6.0.19.1 and 6.0.19.2 reveals an astonishing variety of activities. It shows a very diverse range of uses of buildings and public spaces mixed together in a distributed pattern. Factories and office uses are the second major function of this area following residential use, and this is mostly because of the area’s industrial zoning and development. Open spaces are also used for a variety of purposes in Imazato ranging from parking lots, playgrounds to even cemeteries (see Figure 6.0.20). Parking is a very well-distributed use that exists in both open spaces and buildings. Many shrines and temples, major aged care centers and cemeteries providing related services are also very distributed in both village and non-village area but with limited numbers. However, no street activities in any form can be found across the whole site.

Figure 6.0.21 indicates all the non-residential uses on different levels within each building. Three key findings can be concluded: 1) the ground level has the most diverse activities with stores and restaurants especially numerous; 2) as building levels rise, the number of activities diminishes dramatically, but the diversity still maintains. Level four is the threshold of building floors for a mix of activities to take place; 3) Stores, restaurants, hospitals or clinics and some other building uses can still be found on higher levels of some buildings, which are mostly located on the Superblock’s edges. Factories are mostly up to four levels, whereas offices still occur higher – up to eight levels.
Figure 6.0.19.2 - Imazato Superblock - Distribution of Non-Residential Uses in Buildings

Parking  Park  Shrine
Cemetery  Shopping Street  Sport Playground

Figure 6.0.20 - Imazato Superblock - Distribution of Uses in Streets
Figure 6.0.21 - Imazato Superblock - Distribution of Uses by Floor
Figure 6.0.21 - Imazato Superblock - Distribution of Uses by Floor
6.0.2.2.3 Intensity of Activities

The intensity of the activity mix is measured on the basis of ground floor building use and separately at different levels (see Figures 6.0.22 and 6.0.23). The greater the mix, the higher the level of intensity will be. The two maps indicate a clear message that the area has a high horizontal intensity but low vertical intensity. In other words, more activity mixes tend to locate on the ground level rather than on higher floors of each building. This implies the two-dimensionality character of the built form of the Superblock as discussed before.

Generally, the horizontal intensity is widespread but with mosaic-like higher and lower patches across the Superblock. To a degree, it broadly lessens moving from the edges to the inner area like the layers of an onion. The Superblock is subdivided into 750 sub-areas with almost half (47%) of the Superblock area contains at least two types of functions and about 12% of the Superblock offer access to four types of activities within 50m. The ‘High’ intensity (the mix of three types of activity), and ‘Low’ intensity areas (only one function) are in a similar percentage of about 11% (86/750, 89/750). The areas with 'Medium' level of intensity (the mix of two and three activity types) cover about 19% (142/750). This indicates a medium intensity at a horizontal level but with substantial areas of high concentration.

Vertically, the level of intensity is generally between low to medium with a rather sparser distribution in this Superblock. The areas with higher intensity (the mix of three and four types) can mostly be found along the edges and at corners where subway stations are located. The intensity also shows a very distributed pattern of the mix of two functions scattering in between with one function.
Figure 6.0.22 - Imazato Superblock - Distribution of Mixed Functions - Horizontal

Figure 6.0.23 - Imazato Superblock - Distribution of Mixed Functions - Vertical
6.0.3 Section Three: Interrelationships
Integration

Connection

Interaction

Photos: By Author
6.0.3.1 Integration

Space Syntax is used to understand the space-to-function relationship by analyzing the spatial configuration of Osaka Supergrid and Imazato Superblock. Similar to the analysis of the previous case study, street networks across Global, Glocal and Local scales are analyzed and discussed in this section.

6.0.3.1.1 Analysis of the City Street Network of Osaka:

Within the area that is served by the Supergrid in Osaka, all the public roads and streets are analyzed through the global and local integration measures (see Figure 6.0.24.1 and 6.0.24.2 respectively). The results indicate a moderately high level of integration across the whole city without a 'deformed wheel' or 'spiky potato' shape. In both maps, streets with higher integration (in yellow, orange and red) are mixed with patches of less integrated streets (in blue and green), and they both show a similar level of integration. This is also reflected in the scatter plot, which shows a good global-local integration pattern (see Figure 6.0.24.3). In other words, the analysis implies that the city grid is able to generate movement and activity in an even distribution across the street network of the city in all direction.

The Global roads around Imazato are all in the well-integrated category and the Global road on the West edge is also the most integrated into the city network. However, the streets within Imazato are mostly poorly integrated than the streets in other parts of the city, and those streets form an enclave-like space, which is one of the few poorly integrated groups of streets in the city. This is evident in both maps and it indicates a clear contrast of well and poorly integrated roads and streets in Imazato.
High
Low
Spatial Accessibility/Connectivity
Level of Integration
Global Mean: 1.49
Local Mean: 2.42
Connectivity: 5.05

Figure 6.0.24.1 - Osaka City Road and Street Network - Global Integration

Figure 6.0.24.2 - Osaka City Road and Street Network - Local Integration

Figure 6.0.24.3 - Osaka Scatter Plot - Showing a moderate level of Global-Local Integration

Level of Integration

- High
- Low

Global Mean: 1.49
Local Mean: 2.42
Connectivity: 5.05
6.0.3.1.2 Global Integration (the Supergid):

Space Syntax is also applied to analyze the level of integration of the Supergrid. The analysis of the Global roads network of Osaka only uses global integration (R=n) as indicated in Figure 6.0.25. The result indicates that most Global roads appear in yellow color, which implies an evenly distributed activity and movement intensity of across the city with a moderately high level of integration in general.

The most integrated Global roads concentrate in the inner commercial and Tennoji areas. More integrated roads are aligned north-south in the commercial center, while, in the Tennoji area, highest integration is to be seen in an east-west alignment. Such a distribution pattern shows two groups of ‘most integrated’ roads with lower levels of integration for the Global roads around them.

Imazato Superblock, in comparison, is located in between the more integrated and less integrated part of the Supergrid. The West Global road (in orange color) is the most integrated among the four roads with an integration value of 1.55. It is followed by the Global roads on the North (1.39), South (1.13) and East (1.09) edges. In general, the four Global roads indicate a moderate level of integration.
Figure 6.0.25 - Imazato Superblock - Nanjing - The Global Integration of the Supergrid

Global Mean: 1.08
Connectivity: 3.62
Level of Integration

Local Integration R=n

0
43
0.43
1.70

Ref Number

249
6.0.3.1.3 Glocal Integration (between Superblocks):

Figure 6.0.25.1 shows the global integration (R=n) of the Glocal street network in the area of nine Superblocks. The result illustrates that most Glocal streets are in green and blue showing a low level of movement and activity, the Global roads on the northern and western edges are the most integrated into the area with the highest integration values of 2.57 and 2.33 respectively. It implies that most long distance travel tends to go along the two Global roads in this area.

Figure 6.0.25.2 indicates the local integration of the Glocal street network of the same area. The most integrated streets are the Global roads on Imazato Superblock’s northern, eastern and western edges with values of 4.07, 3.75, 3.59 respectively. This result suggests that although more medium distance rather than long distance travel can be found along the Glocal streets in general, the Global roads along Imazato still serve more medium distance travel than those Glocal streets.

The two maps show a similar distribution pattern. In the area of nine Superblocks, while the integration of the Glocal street network is generally moderate, the Global roads on the northern and western edges are most integrated of the network in both analyses. According to Hillier’s theory, this implies that the Global roads around Imazato have more movement and activity concentration than most Glocal streets. The global-local integration of the Glocal street network is also on a moderate level as indicated in Figure 6.0.26.3.

One very peculiar phenomenon here is that although the Glocal street network looks very dense and well connected, they are not very integrated into the network, especially some Glocal streets in Imazato and the neighboring Superblock on its western side. Those organic streets are particularly poorly integrated.
6.0.3.1.4 Local Integration (within the Superblock):

Figure 6.0.27.1 shows the local integration analysis of the street network of Imazato. The Global roads on the northern, western and eastern edges of the Superblock are more integrated than that on the South. The most integrated streets are not the Global roads, but the two Glocal streets as indicated in red: these are local shopping streets with an average integration value of 2.19.

Figure 6.0.27.2 indicates the local integration analysis of street network by including pedestrian bridges and tunnels. This immediately changes the pattern of integration of Imazato. Three Global roads become the most integrated with integration values of 3.54 (North), 3.42 (East), 3.41 (West). The two Glocal shopping streets are still very well-integrated with integration values of 3.26 and 2.99 respectively. However, other streets are relatively less integrated as indicated in green and blue color. This analysis is closer to the reality than the analysis showed in 6.0.27.1.

The results indicate two major messages. Firstly, the overall integration level of the local street network is moderately low with some well-integrated streets (Global and Glocal streets) and a large number of less integrated streets (Local and Internal streets) in the village area. Secondly, most streets in the non-village area with the regular street pattern are more integrated while streets in the village area have lower integration values.

\[\text{In section 6.0.3.2.2 on page C6-116, the analysis of connection shows that the Global roads have the highest activity density.}\]
Figure 6.0.27.1 - Imazato Superblock Street Network - Local Integration
Global Mean: 1.23
Connectivity: 2.47

Figure 6.0.27.3 - Imazato Superblock Street Network - Local Integration
Local Mean: 1.14
Connectivity: 2.27

Figure 6.0.27 - Imazato Superblock - Local Superblock Integration Analysis
6.0.3.2 Connection

6.0.3.2.1 Street Patterns and Activity Types

The general distribution of all activities is generally well spread. The patterns of streets in the village and non-village area are quite different. Figure 6.0.28 shows the maps that have the superimposition of the street network and all types of activity in separate layers. While it is clear to see that all activities are very distributed, some particular activity types tend to occur at some specific locations that are structurally traceable.

The results indicate that about one-third (29%) of all non-residential activities and more than half (64%) of the residential activities are located along the irregular streets in the village quarter. While 52% of consumption activities are related to the irregular organic pattern, most (88%) production and service (61%) activities are associated with the grid pattern.

Two general findings can be concluded from the four maps. 1) Non-residential activities show a stronger relationship to the regular grid pattern than the irregular pattern. It reflects the Interconnection theory about higher connection generates and attracts more activities, especially non-residential activities. 2) Production type of activity highly relies on the grid pattern, which implies their specific need of having a well-connected street network, whereas consumption activities tend to more rely on the proximity to the residential activities to get more customers to run their business.
Figure 6.0.28 - Imazato Superblock - Connection between Street Patterns and Distribution of Generic Functions (Consumption, Production, Service and Residence)

Consumption
- Total: 878
- Irregular: 457 (52%)
- Grid: 421 (48%)

Production
- Total: 1,782
- Irregular: 219 (12%)
- Grid: 1563 (88%)

Service
- Total: 1,015
- Irregular: 394 (39%)
- Grid: 619 (61%)

Residence
- Total: 37,554
- Irregular: 23,831 (64%)
- Grid: 13,723 (36%)
6.0.3.2.2 Street Types and Activity Types:

Different street patterns in the village and non-village areas show a certain relationship to specific types of streets (see Figure 6.O.29). The numbers of consumption, production and service activities along each type of street are indicated below each map. While activities are very distributed, the consumption activities gravitate most (45.5%) towards Glocal streets while production (38%) and service activities (37.5%) towards Internal streets.

The maps and data also indicate that consumption activities (39%) are most numerous along all Global roads, followed by service (36%) and production (26%) activities. More production activities (49%) concentrate along all Glocal streets, followed by consumption activities (37%) and service activities (18%). Local streets are much more related to production activities (56%) and much less related to consumption activities (14%). Internal streets are also mostly associated with production activities (52%) rather than service (28%) or consumption activities (19%).

The density of each street type and activity is also measured and indicated in Figure 6.O.29. table. It elucidates that Global roads have the highest activity density of all street types, and the activity density shows a positive correlation to the length of streets. However, most activities still evenly distributed along the Glocal streets, which shows its power of distributing activities.
Figure 6.0.29 - Imazato Superblock - Connection between Street Types and Distribution of Generic Functions (Consumption, Production, Service and Residence)
6.0.3.2.3 Street Types and Building Uses:

More specifically, there are certain distribution patterns of building use that can be found to relate strongly to particular street types in the network (See Figure 6.0.30).

1) 92% of restaurants are located along Global roads and Glocal streets.

2) 87% of all stores are located along the Global roads and Glocal streets. Among them, all convenience stores and Supermarkets specifically favor either Global-Glocal or Glocal-Glocal intersections. These are the locations where they can serve both local residents in Imazato and people from its neighboring Superblocks.

3) 90% of banks are all located along the Global roads and Glocal streets.

4) More than 90% of hospitals favor the Global roads and Glocal streets.

5) More than 80% of the schools are located along the Glocal streets.

6) 76% factories are mostly located along Glocal streets. About half of warehouses (58%) and offices (55%) are located along Glocal streets.

7) All post offices are found around Local and Internal junctions, while all logistics are located along Local streets.

8) All shrines, temples, and churches have an association with Internal streets. They are either located directly on Internal streets or at Glocal-Internal T-sections.
Figure 6.0.30 - Imazato Superblock - Connection between Street Types and Building Uses
6.0.3.2.4 Street Densities and Activity Types:

Figure 6.0.31 indicates the relationship between street junctions and activity types. In general, different types of activity show no clear relationships to any junction types, except consumption activities. Where there are higher concentrations of junctions, more consumption activities are to be found. This is especially evident along the shopping street. The result strongly reflects the importance of high frequency of both streets and intersections for the generation of activities, as discussed by Jacobs. However, this is only a valid statement for consumption activity in this Superblock. Residential, production and service activities all show no clear relationships to junctions.
Figure 6.0.31 - Imazato Superblock - Connection between Street Junctions and Generic Functions
6.0.3.3 Interaction

6.0.3.3.1 Street Types and Activity Mix:

Figure 6.0.32 indicates the relationship between activity mixes and the street types. The numbers of mixed consumption-production activities along Global, Glocal, Local and Internal streets are 12, 3, 2, and 1, and the mixed consumption-service activities are 15, 3, 4 and nil respectively. In comparison, the mix of service and production activities can only be found in three locations and they are all along the Global roads.

While the mix of consumption and service activities (in purple) and the mix of consumption and production (in orange) are mostly along Global roads, the mix of service and production (in green) has the weakest relation (10%) with the East Global road. Mixes of three types of activities can only be found at the southwest intersection, where the area’s major subway station is located. In other words, those numbers indicate that the distribution patterns of activity mix demonstrate a strong reliance on Global roads, and the number of activity mix is rather limited.
Figure 6.0.32 - Interaction between Street Network and Functional Mix

Note: When activity mixes are located at junctions, they are considered as having relationships to the two streets that form them.
6.0.3.3.2 Street Types and Building Use Mix:

While most activities and building uses are very distributed, Figure 6.0.33 illustrates some interaction relationships between street types and activity mix that can be found in this Superblock.

The first two maps indicate the mix of all kinds of stores from consumption type (excluding the supermarkets and convenient stores), and parks, shrines, temples, and churches from service type. It is to show where local residents spend money and enjoy outdoor activities. It indicates about 57% relevance between the two types of function.

The second two maps indicate the mix of offices or companies with banks and convenience stores. This is to show where people from the office work to produce, where companies can manage finance through bank service and where people spend money to buy goods. They represent a mix of consumption, production and service activities. About half of the companies are located in proximity to convenience stores. Banks, on the other hand, shows about 60% relevance to companies.

The last two maps indicate the mix of factories and warehouse with parking and logistics and restaurants. This is to show how people work in the factory can get food, how products can be transported to other parts of the city, and where cars can be parked. The result shows that 56.2% of the three types of activities are mixed through the interaction with the street network. This actually reflects the industrial development in this area. Functions are more developed to serve the industrial uses/production activities than other purposes.
Figure 6.0.33 - Interaction between Street Network and Building Uses
6.0.3.3.3 Street Densities (Junctions) and Activity Mix:

The interaction between activity mix and street junction types is indicated in Figure 6.0.34. In general, those maps indicate that the interactions between the street network and functional ‘mix of mixes’ are mostly related to the Global-Glocal junctions.

Because of the limited number of the activity mixes, not many patterns can be found from this group of mapping. The only clear finding is that all the mix of consumption and service activities are located around junctions, and 66.7% (10/15) are located around intersections. Of these, Global-Glocal intersection takes the highest percentage (38%) than all other junction types. Half (3/6) of the mix of production and consumption activities are also located around Global-Glocal intersections. The mix between service and production activities can only be found in three locations in this Superblock, and they show no relationship to any junction types.
Intersection: 10  T-section: 2
Global-Global Intersection: 3
Global-Glocal intersection: 5
Local-Local Intersection: 2
Total: 15

Intersection: 3  T-section: 3
Global-Global Intersection: 1
Global-Glocal Intersection: 3
Glocal-local T-section: 1
Local-Local T-section: 1
Total: 9

Intersection: 1  T-section: 2
Global-Global: 1
Global-Glocal: 0
Total: 3

Intersection: 1  T-section: 0
Global-Global: 1
Global-Glocal: 0
Total: 1

Figure 6.0.34 - Imazato Superblock - Interaction between Street Junctions and Activity Mix
6.0.3.3.4 Street Types and Activity Mix Intensities:

Activity mix intensity occurrence on horizontal and vertical level are shown in Figures 6.0.35.1 and 6.0.35.2 respectively. The results suggest three major findings. Firstly, it is clear that 'High' and 'Very High' intensity occur broadly in the horizontal plane but at very few points vertically (i.e. between floors). This implies a development pattern that treats space as two-dimensional planes and may add evidence for the earlier discussed Japanese floor-oriented spatial conception. Secondly, while the distribution of intensity pattern is well dispersed. 58.5% of the higher intensity areas (mix of two three and four activity types) are related to Global roads and Glocal streets. Thirdly, intensity rises most around Global-Global, Global-Glocal and Glocal-Glocal junctions. Even junctions between Glocal, Local and Internal streets all tend to gather higher intensity. There is the pattern whereby bands of higher intensity wrap around areas of lower intensity. This again corresponds to Maki’s description of the Oku concept of spatial development and also of a floor-orientation.

The limited vertical intensity reflects the Imazato superblock, which has mainly low-rise development. It also reflects an area that is quite flat. Higher intensity (84.2%) shows a clear relationship to Global roads and even more to Global-Global and Global-Glocal junctions.
Figure 6.0.35 - Imazato Superblock - Interaction between Street Network and Function Mix

Figure 6.0.35.1 - The Mapping of the Intensity on Horizontal Level

Figure 6.0.35.2 - The Mapping of the Intensity on Vertical Level

Different Street Types

Different Street Junctions

None

Low - One Function

Moderate - Mix of Two Functions

High - Mix of Three Functions

Very High - Mix of Four Functions
6.0.4 Section Four: Discussion of Findings

The investigation of Imazato reveals some pertinent findings for this thesis as there are some clear relationships between the street network and distribution of activities. It illustrates a clear contrast between a village-like area with an organic street pattern and a non-village area with a regular street grid and street blocks. The regular structure extended from and developed around the irregular area like the process of wrapping a gift to an onion-like structure. Some streets of the irregular area combine to offer great depth and give Oku-like qualities to that part of the Superblock. The physical form across the Superblock does have an overall flatness about it with some higher buildings about the edges. In these ways, Japanese culture and its spatial conceptions (‘areal’ and ‘floor-oriented’) are strongly present.

The visual and numerical data on street types, densities, and patterns all emphasize two types of connection of Imazato: the Glocal-Internal and Local-Internal. While Global roads, Glocal and Local streets in Imazato together construct a well-connected grid pattern, Internal streets are all attached to the Glocal and Local streets in a mix of irregular grid and cul-de-sac pattern. The many Internal streets, which have the densest presence, especially in the ‘village area’, provide the highest number of short-distance travel routes and feed large amount of traffic to those Glocal and Local streets. While Local streets directly lead traffic to the Global roads and the Glocal streets are well-connected to its neighboring Superblocks, some of Imazato’s neighboring Superblocks show very few and even no Glocal connections to the study site. This creates a connection problem at Glocal scale.

All function types are well distributed and constantly interspersed across the whole area. Production activities have by far the highest presence of non-residential types with a tendency to gather along the streets in the non-village area. They are followed by consumption and service activities, which are in about equal proportions, and these concentrate mostly in the village area and along the edges. Activity mix intensity on the vertical level is rare, but very common across the horizontal (ground) level.

The Space Syntax analysis of the city network shows a moderately high to high level of integration, and this similar good integration can also be seen from the analysis of the
Supergrid. However, levels of integration start to collapse at the Glocal and Local scale showing a medium level of integration. This is because a mix of well-integrated and poorly integrated Glocal streets in Imazato's neighboring areas can be found, and the most integrated streets are the Global roads around Imazato. At the local scale, levels of integrations is the lowest, and the most integrated streets are the Global roads and the two Glocal shopping streets. Irregular streets with low integration are often concentrated in the village area. The conditions inferred by the syntax maps generally match the distribution and intensity of functional activities as mapped in the morphology section.

The Connection between the street network and activities indicates some clear relationships. Global roads have the highest levels of activity per street density, followed successively by Glocal, Local and Internal streets. However, while Global streets have the highest activity density, Glocal streets are associated with most non-residential activities in all types, especially the production type. Global roads indicate stronger relationships to consumption activities and mixes of activities. Local streets are associated with more production activities than other activity types but have the weakest relationship to consumption activities of all relationships. Internal streets, in comparison, have the highest concentration of activities but lowest activity density and show a stronger relationship to production activities than other street types. While there is no clear relationship between all non-residential activities and junctions, one clear observation is that consumption activities tend to concentrate around Global-GLocal intersections and in areas with a high frequency of junctions and mix of junction types.

The interaction of activities and streets indicates the importance of Global roads, which record a higher number and higher density of activities than all the other street types. Mixes of consumption and production activities are most numerous and show a clear relationship to Global and Glocal intersections. The activity intensity is higher along the Global roads at the horizontal level and through vertical levels. However, the general activity mix intensity is much higher across the horizontal level than vertical levels. Horizontal intensity is more related to Global-Glocal, Glocal-Glocal and Glocal-Internal intersections, while vertical intensity between activities is a rarity and mostly concentrates along the Global Roads.
6. J Summary and Comparison:

The two Japanese Superblocks, Shijo-Karasuma in Kyoto and Imazato in Osaka, represent two kinds of Superblock in Japanese cities. Although the overall building coverages of the two sites are very close (0.6 for Shijo-Karasuma and 0.615 for Imazato), the population density of Imazato is almost twice that of Shijo-Karasuma.

6.C.1. Form and Function Interrelationship:

There are two spatial relationships and patterns between a Supergrid and its Superblock cells in Japanese cities: one is a regular grid network type that can be commonly found in the central part of a Japanese city, while the other type is a combination of regular and irregular grids with some cul-de-sacs, and the latter type is more typical in most large Japanese cities. This observation is based on the examination of other parts of the two cities, and the study of several Superblocks in Nagoya (by the author in 2013). A similar occurrence was also found in those Superblocks, especially in the Gokiso Superblock in Nagoya (Shelton 2012): it is also in the outer area of the city and has a similar combination of regular and irregular grid forms. In other words, it is reasonable to suggest that the Supergrid and Superblock spatial structures in Japanese cities show some clear organizational ‘rules’: the more central and commercialized areas of Kyoto, Osaka, and Nagoya have more regular grid patterns, whereas Superblocks that are more distant from the center and less commercialized have combinations of regular and irregular grids.

The two study Superblocks both have well-connected dense street networks (more north-south streets) and small street blocks, which are responsible for creating very distributed activities. This reflects Jacobs’ statement about more short blocks, frequent streets, and intersections attracting more and diverse activities. While residential activities are almost everywhere, non-residential activities are interspersed with them to create a highly mixed urban environment with a great diversity of building uses. At the same time, the mixes of activities are rather limited in number and mostly concentrated along the edges. Shijo-Karasuma is part of an extended central area where commercial functions dominate. Imazato
occurs further out from the center where the industrial functions (some old-established) have a strong presence. This can be clearly seen from the diversity of the building uses: while the former site has more hotels and shops, factories and manufacturers flourish in the latter site.

In general, while the city network (including all streets) and the Supergrid in Osaka show much higher integration levels than the ones in Kyoto, levels of integration at the Glocal scale in Kyoto is much higher than the one in Osaka. This is because the neighboring Superblocks around Imazato have a mix of well and poorly integrated Glocal street network. At the local scale, the street network integration of Shijo-Karasuma is also much higher than the one in Imazato, although they both have a well-connected dense street network. This implies that a very connected network does not always equal to a well-integrated network. At the same time, it also confirms Marshall’s study that a pure grid network shows a higher connectivity and integration level than non-pure grid network.

The connections between Global roads and Glocal streets and all kinds of activities are the strongest in both Shijo-Karasuma and Imazato. While the activity density along Glocal streets is the highest in the former site, it is the highest along Global roads in the latter one. However, the total numbers of activities are both the highest along the Glocal streets among all types, and they play significant roles in generating all kinds of activities by connecting internal streets, especially consumption activities. With such Glocal street network, both sites have flow networks that facilitate dispersed distributions of various activities. Moreover, from evidence, intersections of all types are also essential structural elements that can generate and attract more activities to take place, especially of the consumption type. Within this context, Global-Glocal intersections are particularly important in both sites as discovered (e.g. convenience stores can always be found on Global-Glocal intersections).

The interaction between Global roads and activity mix shows the strongest relationship of all street types, and this is very consistent in both sites. While both Shijo-Karasuma and Imazato show very high and high level of activity mix intensity on the horizontal level, the latter indicates a much lower intensity on the vertical level than the former Superblock.
6.C.2 Design Principles and Explanations

There are several design principles that can be extracted from the investigation of the two Japanese Superblocks.

1) A consistent use of a street block structure and dense street network with small buildings

Both Superblocks have clear street block structures and very dense street networks. In the case of Kyoto, where the street block structure has been inherited from the ancient city, the grid structure has remained a strong influence on the modern city’s form. This is the foundation of the modern multidirectional network. Some Global roads are formed pragmatically from remnant Global roads of earlier times and the selective widening of the Glocal street network into a regular Supergrid with slightly deformed sections around train lines, rivers and mountains. In Imazato, the newer areas of the Superblock have developed from and around an old village area where a dense network existed as starting points. New streets were built to construct a more regular but still quite dense grid network but with less depth than is experienced in the village areas.

2) Well-integrated and connected networks across all scales that is formed based on a ‘semi-lattice’ rather than tree-like thinking and spatial organization.

This Superblock structure demonstrates clearly the advantages of forming well integrated and connected multi-directional grids that cross and interconnect scales. This is best reflected in the space syntax maps of Shijo-Karasuma's regular grid street network, which shows a well-balanced integration across different scales. Because the space syntax analysis generally predicts movement in this Superblock, the more integrated a street is, the more activities it is likely to generate. It follows that when movement is multi-directional across scales, activities will be reasonably evenly distributed. While even Imazato also has a well-connected grid network, its irregularity and some cul-de-sacs explain why the level of integration of the street network is relatively weaker than the one in Kyoto, especially at the Glocal scale.
3) An extensive, well-connected and highly integrated Glocal street network across scales is important for generating evenly distributed activities.

The total numbers of activities in relation to the Glocal street network (including all Glocal streets) are the highest in both Shijo-Karasuma and Imazato Superblock. Glocal street type also has the highest activity density and density in the former site, and the highest activity density and the second highest density in the latter site. The way they connect the study sites to their neighboring Superblocks is to make sure the Superblocks become not self-contained cells but open systems that are inter-related to provide medium distance travel. The networks of the two sites are particularly well structured as grids that carry traffic of different modes to and from their surrounding Superblocks. This makes Glocal streets some strategic importance in structuring a Superblock’s street network: they set the skeleton, and therefore Global-Glocal junctions tend to attract more activities and mixes of activities than other junction types.

4) Highly distributed activities with a good horizontal mix in close proximity

Functional activities are well distributed with great varieties on both sites, and it is one of the most striking and distinctive features of Japanese Superblock morphology. Both Superblocks are very mixed with higher intensity horizontally than vertically. It follows that the density and mix of different street types are in a positive relationship with activity intensity and density, and this is very evident in the shopping street in Imazato. It reflects Jacobs’ statement about short blocks, many streets, and more intersections being the essential ingredient for attracting more and diverse activities. It also fits with Jacobs’ advocacy of a mix of building types and street types, and higher frequency of streets as the basis for an active and synergetic environment with a well-distributed pattern of activities. The low vertical intensity, especially in the Imazato Superblock probably reflects the Japanese tendency to develop and expand space two dimensionally (Areal and floor oriented conception).

End of Chapter Six
Chapter Seven: Conclusion
'We must first understand what is unchangeable or resistant to change in order to reach a true understanding of what we must or can change.'

----- Maki 2008, p. 153

7.1 Introduction

This thesis started by contemplating two co-related elements of an urban structure that are commonly found in Chinese and Japanese cities – the Supergrid and Superblock. Together, they form a system that has a long history of practice and can be traced back through more than 2,000 years to ancient China as a planning paradigm. It was also applied to cities outside of China, including the ancient capitals of Japan. Significantly, through engagement with various cultures in different historical epochs, and associated assimilations and importations of ideas, a similar spatial organization remains strongly evident in contemporary Chinese and Japanese cities with new interpretations.

While China and Japan have been transforming their traditional cities to support modern functions by using Western technology, the Supergrid and Superblock structure is a direct product of the process of learning and reading the West through the filter of Eastern culture. While Japan's urban development is now at a mature stage, China is a relative newcomer and still in a rapid process of urbanization of an enormous scale.

However, this is not a smooth journey. As discussed in Chapter Two, China faces a series of urban challenges that are related to this transformation involving conflicts between retaining aspects of traditional culture and functioning as modern cities. As long as this problem is not well understood, China’s urban problems will remain, and there is a danger of great damage to the country through the process of urbanization. At the same time, the populations of Japanese cities are decreasing due to the aging of society (Flüchter 2005 & 2017).
Understanding the merits of the existing city structure should also prove useful for Japan’s future urban development.

While China is looking for solutions for their cities, Japan, sharing a similar cultural background, appears to have some potential solutions. A Master of Urban Design research project that examined a Superblock (Yanagihara) in Nagoya (Chen 2013) and related studies of Japanese Superblocks in the same city (Shelton 2012) alerted this researcher to the importance, problems, and potential of the Supergrid and Superblock structure. Those studies suggest that Japanese Superblocks possess a possible framework for generating Jacobs’ Greenwich Village-like conditions of a good city that have been discussed at length and promulgated in many architecture and planning schools for some decades.

Moreover, with similar experiences of practicing the Supergrid and Superblock structure since ancient time, this research found that both contemporary Chinese and Japanese cities have a deep-rooted and similar multi-directional Supergrid to provide citywide travels. Meanwhile, the structures of the Superblock cells in the Supergrid of the two countries reveal dramatic differences that nurture very different uses of space for residents and visitors alike. While the investigation presents two fascinating types of Superblock structure that reflect Chinese and Japanese cultures, the Japanese structure also shows some interesting features that can usefully contribute to the improvement of the structure of Chinese cities. The structure even has the potential to be an urban design model or tool for cities beyond East Asia, yet there is no systematic understanding of its morphology in existing literature.

Against this background of limited understanding, some solutions have been discussed and practiced in China, and fall into two categories. The first is to replace the Supergrid with a Western-type small grid network, such as
Calthorpe’s proposal for Chenggong city in Yunnan (Calthorpe Associates 2011). Second is to demolish walls in order to remove barriers, ease traffic flow and decrease traffic congestion problem, and this is the major purpose of the official ‘Wall-demolishing policy’ (MOHURD 2016). Nevertheless, the Chinese preference for walls under the influence of the wall-oriented Areal conception in its culture (as discussed in Chapter Two) brought about a reluctance to implement the policy. The majority of people declare the importance of the wall structure for their safety and refuse to remove the walls. It has left an even more perplexing situation for the government, and a greater desire to look for new solutions has been expressed (Huang et al. 2015).

A year before the Chinese government’s policy was published; this author (one year into the thesis) had a similar opinion after reviewing existing literature – that there was a need to demolish walls. This is because the wall structure does create a problem by reducing network connectivity and causing traffic congestion, as discussed in later parts of Chapter Two. However, the examination in Chapter Two and Five indicates that the wall and gate system and the Supergrid and the Superblock structure are brought together as one planning idea that has been used and embedded in Chinese culture and city construction for thousands of years. It is a physical manifestation of a cultural understanding of space. More importantly, the structure has its own logic for generating activities, with many and diverse activities, and many synergies occurring. In parts, levels may even be similar or greater to those found in Japanese Superblocks but in a different presentation. In Chinese Superblocks, the distribution of various activities tends to concentrate together in certain areas, which then attract more activities to cause over-concentration and congestion problems. This is especially evident in the traffic congestion in most of the Chinese cities. In other words, the structure in China needs to be changed in a way that rebalances the movement and activity distribution.
As might be inferred by the quote from Maki at the beginning of this chapter, the wall structure is such a strong cultural element that it should not be demolished. As Friedmann (2005) pointed out, the use of the wall structure has never been fully terminated in China and remains pervasive, especially in the form of gated communities in modern cities: it is as if they are ‘going back towards the future’. China experienced massive demolition of city walls during the Cultural Revolution and it brought only remorse and repentance. Several decades later, people’s reactions to new wall-demolition policy again confirms the importance of the wall structure in Chinese culture and cities and as a social construct. In other words, the wall structure is a founding stone and physical incarnation of Chinese culture and deeply ingrained in the Chinese mindset. Instead of suppressing and erasing it, it may be better to embrace and modify it but make it suitable to the modern world. Otherwise, it will come back again and again with unpredictable influence.

So far, it should be clear that an essential stream of this research is to understand how modern cities can inherit traditional aspects of culture without compromising the functional use of space in modern societies. As Modernization equates less to a process of Westernization, but of Globalization, different cities in the world are homogenized into similar forms and structures geared to maximizing economic development. Traditional culture and city diversity are in danger of exiting the stage of history. This thesis also emphasizes that cities need to be able to adapt to paradigm shifts without losing the merits of traditions.

This issue exists not only in Eastern but also in Western countries, where traditional culture is confronted with modern function linked strongly to economic motives. Since China may be the best example that demonstrates this conflict between conventional and modernity, between cultural preservation and economic development, and between past and future at a dramatic scale, the lessons that China is learning would also benefit the rest of the world. Thus,
although this thesis is a study of the contemporary urban structure in Chinese and Japanese cities, the process of understanding this structure is aimed at embracing a modern world without compromising traditional culture but maintaining cultural sustainability and diversity of the world.

As a comparative study of the Supergrid and Superblock Structure of Chinese and Japanese cities, this thesis interlinks a range of answers to elucidate on three major sub-questions relating to similarities and differences.

1) How does culture influence the formation of the Supergrid and Superblock structure? And how has this been manifested through various transformations?

2) What are the interrelationships between form and function of the structure? More specifically, how does the street network affect the distribution of activities/uses in cities?

3) What are the design principles of the structures, and which ones can be used to improve the structure, particularly in China?

Those questions narrate a story through 1) how urban morphology changes over time under the influence of culture; 2) how parts of cities are related to larger wholes (Integration); 3) how functions are generated and compiled by physical form (Connection); and 4) how synergies can be generated from urban structures (Interaction).

In addressing those research questions, the mystery of the similarities and differences of the structure between the two countries are unveiled and advanced through four major arguments and findings. Key characteristics of the Supergrid and Superblock structure in Chinese and Japanese cities are summarized in Figure 7.1.
7.2 The conclusion of the findings and Key Arguments

1) As a result of similar Areal thinking and multi-dimensional spatial conception, China and Japan share a similar multi-directional grid network at the global scale to provide good cross-city travel. All the Supergrids in the four cities are performing as well-connected and integrated structures. This structure is able to avoid the over-concentration of activities in a single dominant ‘city center’ as is commonly found in the Western cities. This is because such a grid structure can generate more dispersal of movement and activities along the Global roads of the Supergrids with some sort of equality of access.

2) However, the Superblocks within the Supergrids in Chinese and Japanese cities present dramatically dissimilar structures and morphologies. This thesis argues that the wall-oriented and floor-oriented spatial conceptions in the two cultures are highly influential on these physical differences. This cultural influence is very evident through various historical transformations, which construct a palimpsest as the foundation for the formation of the contemporary structures.
3) The different Superblock structures further contribute to the formation of two types of functional distribution of various activities and uses of urban space. The 'wall and gate' structure of the Superblocks in China works as the activity dynamo and diffuser, partly restructuring and partly replacing the pattern of the street network. In comparison, the street network is the predominant generator of movement and activity in Japanese Superblocks. Correspondingly, Superblocks in Chinese cities exhibit a co-existence of saturation of activity types and mixes as well as a separation of residential and non-residential functions. In comparison, functional activities are consistently presenting a more dispersed but relatively even distribution of activities across Superblocks in Japanese cities.

4) The difference between the two Supergrid and Superblock structures also reveals indisputably, the importance of the Glocal street networks. It is not only the number and density of Glocal streets that are crucial, but also the levels of integration and connection and interaction within the wider Glocal and Global networks. Glocal streets are the key to ‘all-round' access to services and facilities within the locality (i.e. the immediate and neighboring Superblocks) and to more distant ones via the Global roads. Yet well-integrated Glocal streets are the missing links in the structure of the Chinese cities. This provides strong indication of their importance (the priority element) for improving Superblock Structures in Chinese cities.

5) While superblock spatial structures present clear variations that accord with the different cultural backgrounds and form divergent patterns in the use of urban spaces, the major findings also reflect core characteristics of Interconnection Theory as synthesized in Chapter 3: namely, that physical structure has a deterministic impact on movement patterns and distribution of activities, and a positive structure-movement-activity interplay is both complex and fundamental to a city's effectiveness.

These arguments and findings are further elaborated in the sections below.
7.3. Similarities and Differences of the Structure between China and Japan

7.3.1 The Similarities between China and Japan

The street networks in China and Japan both take the form of a multi-directional grid network of wide Global roads over broad urbanized areas of cities (see Figure 7.2). They both have a similar average interval between roads of about 1km, to create a city skeleton with a number of Superblocks as cells. In both countries, a city Supergrid can be regular and irregular under the influence of the particular geographical and heritage features.

Figure 7.2 – The comparison of the Supergrids and the location of the study sites in each city
As discussed in Chapter Two, Eastern culture’s ‘Areal thinking’ and multi-directional spatial conception have had major impacts on and underlie the Supergrid form. In both countries, added influences in modern times come from Western road and traffic technologies. While the Eastern cultural influence was ‘born’ in ancient China and migrated to Japan, those ancient planning concepts are still evident in the contemporary cities of both countries but with added modern Chinese and Japanese interpretations.

With the importation of Western technology since the late 19th century, this idea of a Supergrid was a ‘natural’ formation under the Eastern cultural spatial conception. It is especially evident in the case study of Nanjing where the Western small (not Super) grid structure was replaced by a Supergrid network, which fits the Chinese cultural understanding of spatial demarcation (Chapter Five, 5.N.1.2). Similarly, Kyoto and Osaka adapted the Western tram technology but implemented it as a Supergrid system rather than Western radial layout. These tram networks are an early prototype of the modern Supergrid and Superblock structures (Chapter Six). In other words, the formation of the Supergrid in Chinese and Japanese cities is an ‘Areal’ spatial practice that combines the Western technology and Eastern spatial conception.

7.3.2 The Difference between China and Japan:

While China and Japan share the similar multi-directional Supergrids, differences occur within the Superblocks, where the variant ‘wall’ and ‘floor’ oriented spatial conceptions are exemplified most (see Figure 7.3).

As concluded in Chapter Five, the two Superblocks in China indicate the same principle of spatial organization, with the pervasive use of wall and gate structure as the major component in controlling and restructuring the street network. The Jinyuan in Xi’an and Daguangli in Nanjing represent two types of
Superblocks in more central and edge parts of the Supergrid respectively. Both are surrounded by Global roads that enjoy some level of equality within the global network. Both indicate high levels of self-containment within the superblocks. Neither is well-integrated or connected at Glocal and Local scales, and Jinyuan has a far less connected structure than Daguangli Superblock.

While Xi’an has a large number of gates locating along the Global roads, Nanjing has more gates sitting along the Glocal streets. As a consequence, more activities are gathered along Global roads in Xi’an, whereas most are concentrated along Glocal streets in Nanjing. Thus, the wall and gate structure is the major factor influencing the distribution of activities in the street network because it is the locations of the gates that determines where most movement and activities will take place. Local and Internal gates attract and generate most activities, followed by the junctions of Global roads and Glocal streets. The results strongly indicate the dominant role of the wall and gate structure as the main generator of activities, especially when they are mapped together with the street network.

[Image: Figure 7.3 – The Comparison of the Street Network within the Superblock in Xi’an (Jinyuan, left) and in Nanjing (Daguangli, Right)]

In comparison, Chapter Six concludes that the two Superblocks in Japan operate on a different principle of spatial organization that relies on the street network.
without impact from walls and gates (see Figure 7.4). The Shiji-Karasuma Superblock in Kyoto is much more regular as it is commonly found in the central part of a Supergrid, whereas the Imazato Superblock in Osaka is on the edge of a Supergrid and has a mix of regular and irregular grids. Representing two types of Japanese Superblock, the two exemplars reveal the importance of having a well-connected and integrated network not only within the Superblock but also across scales. Because they both have a well-connected network, each Superblock functions as a relatively self-contained area and also as an integrated part of the wider city. In the comparison of the two, Shijo-Karasuma presents a well-integrated network across scales, whereas Imazato has a mix of a well-integrated and less well-integrated network.

Furthermore, the dense grid street networks within the two Japanese study Superblocks are also responsible for creating an evenly distributed but reasonably dense pattern of activities that provides close proximity between varied uses. It shows the predominant role of the street network as the generator of activities. Within this framework, some locations in the network tend to attract even more activities, such as Global-Glocal, Glocal-Glocal or Glocal-Local/Internal junctions.

Figure 7.4 - The Comparison of the Street Network within the Superblock in Kyoto (Shijo-Karasuma, left) and in Osaka (Imazato, right)
7.3.3 Comparison between Xi’an and Kyoto

The Global road networks in Xi’an and in Kyoto are very similar because they are both networks of regular grids. The interval between Global Roads is also similar at about 1km, although the Supergrid is more extensive in Xi’an than in Kyoto. Differences start to exhibit at the Glocal scale, where the number and density of Glocal streets in Shijo-Karasuma is more than three and ten times as many as in Jinyuan. At the Superblock scale, the street density and number of Local and Internal streets in Jinyuan is four and six times less than the density and number in Shijo-Karasuma. While the number of junctions is similar in both Superblocks, the junctions in Jinyuan are mostly T-sections in the form of gates resulted from a tree pattern and Shijo-Karasuma is structured by a grid pattern across all scales forming mostly intersections. Using Alexander’s term, the street network in and around the two Superblocks are respectively tree and grid systems showing a higher connectivity in Shijo-Karasuma than in Jinyuan.

Further, similar patterns to those found within Jinyuan and Shijo-Karasuma Superblocks can be found repeated in the eight neighboring Superblocks around each of them, creating two very divergent structures at the Glocal scale. Jinyuan has a disintegrated and disconnected Glocal street network, while in Shijo-Karasuma, Glocal streets are well-integrated and connected across scales. It became clear that the major reason for a lack of connectivity in the former Superblock is not simply because there are few Local and Internal streets, but primarily because a well connected and integrated Glocal street network is missing.
These differences in Superblock structures are further responsible for creating two different sets of activity distributions through the interplay of structure, movement, and activity (see Figure 7.5). In the Jinyuan Superblock, activities are highly concentrated along the Global roads, which are where most of the gates are located. This is because gates take more control of traffic flow than streets in a Chinese Superblock. Movement, as the generator of functional activities, is therefore mostly directed to and concentrated along the Global roads, where vehicle and pedestrian flows are highly concentrated. Hence, there is an uneven distribution of activity in the Superblock and a problem of over-concentration along Global Roads. In this situation, the gates attract many economic activities and create congestion at the same time.

In comparison, functional activities are widely distributed both horizontally and vertically across the whole area of the Shijo-Karasuma Superblock. While most activities can be found along the Global roads and Glocal streets, the latter have higher activity densities and are distributing three times more activities than the Global roads. This clearly shows the importance of Glocal streets in a grid network for distributing activities.
7.3.4 Comparison between Nanjing and Osaka

The Global road network in Nanjing bears some resemblances to Osaka’s: both have a multi-directional grid mixing with occasional radial elements. The intervals between the Global roads in the two cities vary but show a similar average of about 1km. Some similarities between the two networks remain amongst Glocal streets at the Glocal scale, where the Glocal street networks in the area of nine Superblocks start to fragment and diverge in their Glocal connections with neighboring Superblocks. While Glocal streets between Daguangli and neighboring Superblocks are far less effective and the Superblock is poorly connected to the wider area. Glocal streets in Imazato Superblock show a mix of strong and weak connections to its neighboring Superblocks.

In addition, both Daguangli and Imazato Superblocks have more T-sections than intersections. They are mostly Glocal-Internal gates in Daguangli but Glocal-Internal streets in Imazato. Surprisingly, Daguangli has a more integrated network than Imazato, even though the former shows lower connectivity levels because of the prominence of cul-de-sac/tree street patterns. This indicates that a well-connected network is not always well-integrated.

As a consequence, they both show similar structures with Glocal-Internal connections as the major type in their networks, and low levels of integration at Glocal scale. Even though Imazato has a more connected and integrated structure than Daguangli since its T-sections are further connected to other streets (rather than to private spaces) to form an irregular grid, much movement in the two Superblocks is redirected back to the Global roads causing concentrations of non-residentical activities and movement on those roads.
However, the distributions of activities in the two Superblocks are divergent (see Figure 7.6). The structure in the Daguangli creates a clear separation of residential and non-residential activities, while the activities in Imazato are more evenly distributed. Non-residential activities are mostly concentrated along both the Global and Glocal streets in the former Superblock and particularly around Internal and Local gates; whereas they are mostly well mixed with the residential activities in Imazato. Again, walls and gates are the major controllers of movement from the streets in the Chinese Superblock, while streets work as the only determinant in the Japanese case. This again reflects the ‘Movement Economy’ mechanism and the power of walls.

Further, such interrelationships between the street network and activities are both reinforced by and also contribute to the structure and movement pattern of public transportation. While subways and bus lines are only for inner and intra-city travel, they are all constructed along the Global roads to follow the Supergrid network. This has the effect of distributing movement more evenly along the Global Roads and also of collecting more people and re-distributing them into the Global Road system. However, this is only true if the Global Roads are equipped with generous sidewalks. This is because the Global ‘sidewalk
streets’ as Shelton (2012) has suggested are effectively part of the Glocal street network. In this way, they are a crucial mediator to collect and transfer movement (and mix activities) between scales.

Vehicular movement shares many more similarities at Global scale in the four case studies as in all cases, high cross-city volumes flow along the Global roads network. However, these are also strongly influenced by the traffic controls within each Superblock, especially in the Chinese cases. This is because the traffic is organized in a way that it is repeatedly re-directed back onto Global roads. The situation is most extreme in Xi’an, where cars are forced to travel on the four Global roads even for short-distance travel, creating high traffic concentrations on those roads because of the scarcity of Glocal streets and the many Local gates along the Global roads. Nanjing shows some similarities: although most cars flow from the Internal gates onto Glocal streets, a lack of well-integrated Glocal streets and related traffic controls again re-direct flows back onto the Global roads. The result of these structures in the two Chinese cities is a similar over-reliance and excessive traffic concentration on Global Roads.

7.3.5 Comparison of the Four Superblocks in a Summary:

Integration:
Two sets of data are generated from the Space Syntax analyses as discussed in Chapter 5 and 6. Figure 7.7 indicates the level of integration of Supergrid and Superblock structures in two Chinese and two Japanese cities by comparing the Global, Glocal and Local mean of integration values and connectivity values. Among the four study sites, the results indicate that Xi’an has the most integrated...
Supergrid at Global scale; and the Superblock network in Kyoto is the most integrated at Glocal and Local scales with highest connectivity values. The site in Nanjing is more integrated at Glocal and Local scales than the site in Xi’an. While the Superblock in Osaka is the least integrated at the local scale, it is not the least integrated at other scales (see Table 7.1).

Figure 7.7 – Comparing Integration levels of the street network in the four cities

Table 7.1 – Comparing Integration levels across scales in the four cities
Connection:

Comparing data from Chapters 5 and 6 on numbers of non-residential activities and the densities of these along each type of street (see Figure 7.8), the following comparative conclusions can be made: 1) Global Roads have the strongest relationship with non-residential activities in Jinyuan Superblock, Xi’an; 2) Glocal streets have the strongest relationship with non-residential activities in Shijo-Karasuma Superblock, Kyoto; 3) While the Glocal street network has a higher concentration of activities, activity densities along Global roads and Glocal streets are almost the same (The Global road type is slightly higher than Glocal street type); 4) The most hierarchical structure to be found is in Imazato where the relationship between street length and activity density shows a clear and consistently positive correlation.

Interaction:

Three consistent findings can be concluded as important from the four sites:

1) There is a clear relationship between Global roads and activity mix on both horizontal and vertical levels.

2) Higher intensities of activity mix are related to a greater mix of street types

3) Higher intensities of activity mix are also related to Global and Glocal junctions.
7.3.6 Comparison of the Design Principles:

With an understanding of such similarities and differences between the Supergrid and Superblock Structure in Chinese and Japanese cities, some key design principles may be selected and summarized for each case. Further, some comparisons become more apparent by placing these side-by-sides in tabular form as indicated in table 7.2.

<table>
<thead>
<tr>
<th>Design principles in China</th>
<th>Design principles in Japan:</th>
</tr>
</thead>
<tbody>
<tr>
<td>o A grid configured network is structured as a basic skeleton, which serves city-wide travel and gives definition to Superblock cells.</td>
<td>o A grid configured network is structured as a basic skeleton, which serves city-wide travel and gives definition to Superblock cells.</td>
</tr>
<tr>
<td>o Each Superblock within the skeletal grid is divided into walled compounds of varying sizes.</td>
<td>o Each Superblock within the skeletal grid is constructed with a mix of street types and junction types to provide a network offering high levels of connectivity across scales. (The importance of an effective Glocal network cannot be stressed too highly.)</td>
</tr>
<tr>
<td>o Constructed within these compounds are separate private, usually tributary or tree configured, street systems that are linked to a public street system via gates.</td>
<td>o This street-based structure offers more or less direct connection between streets and individual buildings</td>
</tr>
<tr>
<td>o Also constructed within these compounds is a range of building types – towers, slabs, pavilions, etc.</td>
<td>o Street form is related to building form as street width is a factor in determining building height through the slope plane rule (regulation). Related to street type,</td>
</tr>
</tbody>
</table>
buildings and streets are required by law. However, strict regulations are imposed on distances between residential buildings within each walled compound.

<table>
<thead>
<tr>
<th>Chinese Superblocks</th>
<th>Japanese Superblocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A wall structure is utilized to separate most residential and non-residential activities from each other.</td>
<td>A wide range of activities and building uses are encouraged to mix along streets and in buildings through an inclusive zoning policy (regulation).</td>
</tr>
<tr>
<td>Gates to compounds are distributed irregularly (and mostly along Global and Glocal public roads and streets).</td>
<td>Gates can be found in Superblocks, but usually in the form of entry to residential houses or individual buildings. They do not create a strong obstruction to movements over extensive areas.</td>
</tr>
<tr>
<td>Gates and compound spaces mediate between public streets and individual residential buildings.</td>
<td>Generally, no clear physical structure exists to distinguish private streets and public spaces in Superblocks.</td>
</tr>
<tr>
<td>Street markets and vendors are allowed to conduct business outside walled compounds on public streets in the vicinity of compound gates.</td>
<td>Street markets and vendors are restricted and usually found only at special events such as festivals. The Shotengai or shopping street (often covered) is the most common form for sale of retail items and services; and these normally locate within a Superblock or sometimes cross from one Superblock to another.</td>
</tr>
</tbody>
</table>

Table 7.2 - Comparison of the Design Principles of Chinese and Japanese Superblocks
7.4 Advantages & Disadvantages of the structure between China and Japan

The strongest advantage of the Chinese Superblock structure is that it can be easily managed and controlled with greater security and protection for a large number of people. While the Superblocks are self-contained in structure, this can prevent significant amounts of traffic from passing through the walled residential area and thus create quieter and more comfortable living environments. It is also easier to collect and concentrate people and to redirect and restrict flows and movement. This means that it is much simpler to predict and control where activities can take place and where a large number of individuals can gather in space. As a result of the structure, the synergies generated from the ‘movement economy’ are around the gates.

However, these strengths of the structure are also part of the problem. They exacerbate the issues of congestion and over-concentration. The problems become even more dramatic and harmful when the wall structure in a Superblock is constructed on a larger scale and detached from the street network. Further, the biggest disadvantage of the wall structure is that it creates difficulties for the construction of well-connected Glocal streets and effectively brings disintegration to the Glocal network as previously discussed. Thus the Wall and Gate structure are both advantages and disadvantages – for offering protection and generating activities but also over-concentrating and isolating activities, and impeding movement.

Whereas in Japan, the Superblocks are more connected and integrated across scales, with generally far superior integration and connection at the scale of the Glocal street network. With many densely connected and integrated Glocal streets, people do not necessarily need to use Global roads to travel a medium distance.

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1 This idea is also used in the modification of Barcelona’s city grid, which are converted into Superblocks for the same purposes (see more in Adjustment de Barcelona 2014).
distance for multiple purposes. The street-oriented structure also indicates a more flexible network that encourages or deters movement through certain street types with graded levels of connection and width. A more connected grid network of streets with various street types can provide greater freedom of movement within and between Superblocks. At the same time, the structure can ease congestion, and prevent over-concentration or isolation without sacrificing diversity of activity.

However, although more through traffic may have its merits, it may also be disturbing to residents: more vehicle movements and non-residential activities mixing with residential functions can create an unpleasant living environment with more noise and pollution. The structure is also not very suitable for managing a large number of people as groups and distributes resources because of the dispersion. The amount of public leisure space and space for living purposes may also be compromised by the construction of more roads and streets.

It is clear that the Supergrid and Superblocks structures in China and Japan present two distinct variations of a type of city structure that serve similar purposes but arise from and suit different urban contexts and cultures. They have the same Supergrid system, but different Superblocks, which perform well in generating diverse activities. However, the structure in China can easily lead to congestion and over-concentration in specific points of the structure and the merits of Japanese structure do provide clues for the improvement of Superblock structures in Chinese cities.
7.5. A Potential Solution for Improving the Superblock Structure in China

While the investigation of the Chinese Superblocks indicates some clear design principles, it also draws attention to several problematic issues. Although Japanese Superblocks are not without some problems and disadvantages, the investigation of those Superblocks indicates clear design principles, some of which have value for improving Superblock structure in Chinese cities.

In general, two possible approaches suggest themselves for the improvement of Chinese Superblocks.

Because of the limited number of Local and Internal streets, the first approach could simply be to increase these streets as a part of the public street network to improve the street connectivity. It is also the main purpose of the wall-demolishing policy published by the Chinese government.

At first glance, the investigation does show a lack of Local and Internal streets in the two Chinese Superblocks because of the existence of the wall and gate structure. The result of such change (more Local and Internal Streets) can solve some congestion issues in Chinese cities in the short term because theoretically there is evidence that more connected networks of streets do assist movement and the generation of a distributed pattern of activity (as found in Imazato). Nevertheless, this study also shows that the two street types have low activity density – that is they do not attract or generate as many activities as Global and Glocal streets in a pure street network. Moreover, having a large amount of Local and Internal streets can also restrict movement by confusing travelers and destroy a more synergetic environment. As a result, the most movement will still go along the Global roads, and the creation of those Local and Internal streets are actually not efficient or in vain. This is also very evident in the Imazato Superblock in Osaka, which has the least integrated street network with a
moderately low level of connectivity compared to the other three sites. This is largely because of 1) the lack of well-integrated Glocal streets in some of its neighboring Superblocks, and 2) there are too many Local and Internal streets with some depths even though they are in a grid pattern. As a result, the strongest concentration of activities and activity mixes are still along the Global roads.

In addition, this solution could lead to further (social) problems in Chinese cities. It is because the wall structure needs to be demolished in order to create more Local and Internal streets and walls are a valued part of the social environment (security) and cultural fabric in China. As a cultural element, the wall structure may well return in the future as happened in the past when previously demolished walls returned in the modern era with even stronger impact (as discussed in Chapter Two).

Moreover, demolishing walls will have to contend with other problems. Firstly, because private streets in existing walled areas are already mostly in cul-de-sac patterns. This means that by converting those private streets into public Local and Internal streets, they will still be in tree structures, and forming isolated groups of cul-de-sac patches. In other words, the problems will remain if nothing is done to connect all of them. Also, linking them will not only require many adjustments to the existing street networks but also create management problems since they are owned by different companies.

In comparison, a second approach is to create a network of well-connected and integrated Glocal streets across scales as a skeleton. This can resolve the issue of over concentration without demolishing the wall and gate structure.

As explained earlier, in a pure street structure, Glocal streets not only attract more activities than Local and Internal streets, they also provide alternative
routes to Global roads for medium distance travel and so ease traffic pressure on Global roads. The use of Glocal streets as such an alternative is most evident in the Shijo-Karasuma Superblock. The Glocal streets not only offer a very well integrated street network across scales as a Glocal structural skeleton to provide a very good connectivity, they also have the highest activity density in Shijo-Karasuma and the highest concentration of various activities in both Japanese Superblocks creating an even but dense distribution.

While the location of the gates is the key determinant of movement and activity distribution in a Chinese Superblock, the walls and gates still rely on a street network as a base. This means that Chinese cities need a good foundation network to start with. Nevertheless, there is a network deficiency in China’s Superblocks as found in the two Chinese sites. The key player, the Glocal street network is missing and/or poorly integrated causing the structural problems in Chinese cities. As the investigation makes absolutely clear, the numbers and densities of Glocal streets in the two Japanese Superblocks are about five times higher than in the two Chinese cases, and they both have the highest concentration of activities. In other words, introducing more Glocal streets in Chinese Superblocks would assist immediately in improving the connectivity and in generating a more distributed pattern of activities.

More importantly, Glocal streets have to be well-integrated across scales. This requires a well-connected and integrated Glocal street network amongst neighboring Superblocks with good connections on all sides of any one Superblock (as found in and around Shijo-Karasuma). In comparison, Daguangli and Imazato Superblocks both have integration issues. They rely mostly on the Glocal-Internal type of connection, while showing few good connections and to other Glocal streets in neighboring Superblocks and low integration levels at this scale. As a result, both have high concentrations of activities along the Global roads. Even in Imazato, with a large number of Internal streets, concentration on
the Global roads still exist. In comparison, Daguangli has a better distribution in distributing activities along Global and Glocal streets than Imazato. This explains the numerical findings as presented earlier.

Because gates are the major threshold for controlling traffic and influencing the location of activities: consistent with Hillier’s concept of ‘movement economy’, the location of the gates in this Chinese city structure decides where most movement will occur and further, where most activities will be located. By increasing the number and density of the Glocal streets to form a grid, a fairly even distribution of gates along Global and Glocal streets will create more evenly distributed patterns of movement and activities. In this way, the issues created by the physical structure can be solved, and the wall structure, which represents the social and cultural fabric in Chinese cities, can be maintained.

A proposed model is presented for the future of China’s Supergrid and Superblock development based on the second approach: that is to keep the wall structure and create a more evenly distributed pattern of functional activities by having a well-connected and integrated Glocal street network, which is connected to more internal streets and gates (see Figure 7.9 and 7.10).

![Figure 7.9 – Proposed model for a Superblock showing its position in the Global Grid in a group of 9 Superblocks](image-url)
Key Design Principles and Guidelines for the Proposed Model

Street:

- A clear hierarchical structure is created of Global roads, Glocal streets, Local and Internal gates, although some Local and Internal streets may be built to supplement gates.
- Global roads are normally between 25m and 50m wide and include generous sidewalks on both sides.
- Glocal streets are required to connect neighboring Superblocks and form integrated Glocal street networks (see Figure 7.9, the orange lines). When these occur between walled compounds, where existing Superblocks are being improved, this will likely involve some demolition of walls.
- Glocal streets do not generally extend for more than 3km in length (the length of three Superblocks) and provide channels for mainly medium distance travel.
- Local and Internal gates are distributed with some regularity along the edges of each block, preferably at intervals of not more than 100m
Blocks:

- A Superblock is made up of smaller blocks or walled compounds but with variation in compound size.
- Although block sizes may vary, it is preferable that the area of each walled compound is less than 62,500m² with each edge of a compound no more than 250m in length. To an extreme, the edges of a compound can go up to 400m at maximum but with at least four gates on each side to provide more permeability.

Built Form:

- Each block should be surrounded by buildings or other structures at the edges. These edge buildings would create a clear distinction between 'inside' and 'outside', thus performing the role of a wall for safety and protection.
- The height of the edge buildings could vary according to street widths. Buildings along the Global roads (as indicated in red in Figure 7.10) can be built higher than the functional edges along the Glocal streets (as indicated in orange in the same figure). Preferably up to 4 levels along Glocal streets, and up to 8 levels along Global roads.
- The buildings within each walled area can be built in any form type: pavilions, slabs, towers, etc. in varying densities and mixes.
- The buildings at the edges and inside together make a gated compound.
- Gates can be built as part of the edge building with clear separation of people and cars for access.

Function:

- All edge buildings of each Superblock need to host a great variety of uses. Examples are hotels, recreation corners, restaurants, various shops, clinics, schools, banks and car parks but the list may be greatly extended. In other words, they can also be seen as a multi-functional perimeter edge effectively replaces the wall structure to protect the residents inside.
• Intersections are locations for cafés and hotels with convenience stores, food stores and restaurants around gates.

In this proposed model, the pattern of activities will be much influenced by the Glocal-Local gate and Glocal-Internal gate types of connection. A more or less even distribution of the gates ensures a well-distributed pattern of movement and activities across the Superblock.

Although the government claims that China should have more open neighborhoods in the future, the solution proposed in this thesis stresses the importance of the wall structure and demonstrates the possibility of keeping the closed neighborhood without compromising the basic need for better traffic circulation, better safety and more convenience for urban life.

The proposed model as shown above is an indicative prototype and the design principles are also general and open, which gives flexibility in application. The principles need to be applied to particular circumstances, rather than viewed as a rigid solution. Hence, quantitative parameters for the application of the model are limited. The proposal combines the structural advantages that have been identified in the Japanese Superblock with the Chinese wall structure, which is a representation of culture and social preference. It is intended to assist the new wall-demolishing policy in China directly as a straightforward and practical application. This model is also influenced by the famous ancient Chinese Supergrid and Superblock model used to build traditional Chinese cities (including ancient Xi’an). It is, therefore, a good example of an approach that combines traditional Chinese culture and the merits of the related Japanese Superblock structure.
This thesis investigates a Supergrid and Superblock structure that is rooted in Eastern culture, which formulates its own spatial conceptions and urban structures. The consequent physical structures, respectively wall-dominated and street-dominated create contrasting functional use patterns. In Chinese Superblocks, residential and non-residential uses are more separated with a great concentration and mix of non-residential activities around gates. In Japan, residential and non-residential uses are relatively mixed and evenly distributed, and this provides a potential solution for China's urban problems.

The structural key behind the distributed pattern in Japanese Superblocks informs the importance of a well-connected and integrated grid network of several street types across scales that provide a range of connections to meet the need of short, medium and long distance travel. Accommodating a wide range of movement modes and associated with building regulations that link building size to street width, the street network is the major component of the Japanese urban structure that generates a varied but dense and well-distributed mix of uses: this is consistent with Space Syntax theory and the notion of a ‘movement economy’.

The findings from this investigation suggest overwhelmingly that the drawbacks of the Chinese Superblocks are not fundamentally caused by the wall and gate subject per se but the absence of a well integrated and connected Glocal street network. The proposed model is both example of improvement and further explanation of the mechanisms behind the effective operation of a successful Superblock. Japanese Superblocks have provided insight and inspiration for improvements to those in China, although not quite in the manner envisaged at the start of the research (problems also exist in Japanese Superblocks): this is the value of a systematic research method.
In this whole process, the study is one of understanding the Supergrid and Superblock structure in two related (Eastern) but divergent (Chinese and Japanese) cultural contexts, and of the merging of Eastern spatial ideas with the forces of modernization. At this level, it has unraveled some mysteries that are encoded but previously hidden in the Supergrid-Superblock structure. It provides a direction for other countries struggling with the same problem of adapting the traditional urban form to meet the requirement for modern developments. Particularly, it offers new insights into an old model that should be of interest to all cities with Supergrid and Superblock systems (or simply with Superblocks) and to cities that may be considering such systems for the future.

End of Thesis
Addendum: Experimental Design and Modification

This is effectively an addendum to Chapter 7.
To the realization of a proposed model, example interventions of the proposed principles are presented in this section to provide further explanations.
A. Introduction

This is a design addendum to the proposed model in Chapter 7. It provides a direct explanation of the possible application of the proposed model and design principles through two experimental designs of the two case study Superblocks in the Chinese cities. The modifications not only reveal the issues of the structures in Jinyuan and Daguangli Superblocks as discussed earlier but also deliver a potential solution to improve the structure through the proposed model and design principles. It is important to note that these experimental designs are only indicative of possible solutions, because the modification of the structure involves further investigation of land ownership and jurisdictions in different governmental departments and third parties.
A.1.1 Modification of the Jinyuan Superblock in Xi’an

Jinyuan Superblock Modification Diagram

Figure A.1.1 – Jinyuan Superblock Modification Diagram at Local Scale
Figure A.1.2 – Jinyuan Superblock Glocal Street Improvement at Glocal Scale
A.1.2 Modification of Daguangli Superblock in Nanjing:

Daguangli Superblock Modification Diagram

Figure A.2.1 – Daguangli Superblock Modification Diagram at Local Scale
Figure A.2.2 – Daguangli Superblock Modification Diagram at Glocal Scale
# Appendix One

**Ap. 1. Chronological Outline of Chinese History:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Dynasty</th>
<th>Dynasty Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca. 10,000-2,000 BCE</td>
<td>Prehistoric China</td>
<td>Neolithic Cultures</td>
</tr>
<tr>
<td>ca. 2100-1600 BCE</td>
<td>Early Bronze Age of China</td>
<td>Xia (Hsia)</td>
</tr>
<tr>
<td>ca. 1600-1046 BCE</td>
<td></td>
<td>Shang</td>
</tr>
<tr>
<td>ca. 1046-256 BCE</td>
<td>Ancient China</td>
<td>Zhou (Chou):</td>
</tr>
<tr>
<td>ca. 1046-771 BCE</td>
<td></td>
<td>Western Zhou</td>
</tr>
<tr>
<td>ca. 771-256 BCE</td>
<td></td>
<td>Eastern Zhou</td>
</tr>
<tr>
<td>ca. 770-476 BCE</td>
<td></td>
<td>Spring and Autumn Period</td>
</tr>
<tr>
<td>ca. 475-221 BCE</td>
<td></td>
<td>Warring State Period</td>
</tr>
<tr>
<td>ca. 221-206 BCE</td>
<td>Early Imperial China</td>
<td>Qin (Ch'lin)</td>
</tr>
<tr>
<td>206 BCE-220 AD</td>
<td></td>
<td>Han</td>
</tr>
<tr>
<td>206 BCE-9 AD</td>
<td></td>
<td>Western/Former Han</td>
</tr>
<tr>
<td>25-220 AD</td>
<td></td>
<td>Eastern/Later Han</td>
</tr>
<tr>
<td>220-589 AD</td>
<td>China’s ‘Middle/Dark Ages’</td>
<td>&quot;Period of Disunity” or Six Dynasties Period</td>
</tr>
<tr>
<td>581-618 AD</td>
<td></td>
<td>Sui</td>
</tr>
<tr>
<td>618-906 AD</td>
<td></td>
<td>Tang</td>
</tr>
<tr>
<td>907-960 AD</td>
<td>Medieval China</td>
<td>Five Dynasties and Ten States</td>
</tr>
<tr>
<td>960-1279 AD</td>
<td></td>
<td>Song</td>
</tr>
<tr>
<td>960-1127 AD</td>
<td></td>
<td>Northern Song</td>
</tr>
<tr>
<td>1127-1279 AD</td>
<td></td>
<td>Southern Song</td>
</tr>
<tr>
<td>907-1125 AD</td>
<td>The Final Dynasties</td>
<td>Liao</td>
</tr>
<tr>
<td>1038-1227 AD</td>
<td></td>
<td>Western Xia</td>
</tr>
<tr>
<td>1115-1234 AD</td>
<td></td>
<td>Jin</td>
</tr>
<tr>
<td>1279-1367 AD</td>
<td></td>
<td>Yuan</td>
</tr>
<tr>
<td>1368-1644 AD</td>
<td></td>
<td>Ming</td>
</tr>
<tr>
<td>1644-1911 AD</td>
<td></td>
<td>Qing (Ch'ing)</td>
</tr>
<tr>
<td>1912-1949 AD</td>
<td>Early Modern China/ The</td>
<td>Republic Period</td>
</tr>
<tr>
<td></td>
<td>Republic of China Ear</td>
<td></td>
</tr>
<tr>
<td>1949-present</td>
<td>Contemporary China</td>
<td>People's Republic of China</td>
</tr>
</tbody>
</table>

*Table A. 1 – The Chronological Timeline of Chinese History (by author)*
**Ap.2. Chronological Outline of Japanese History:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca. 10,000 – 3000 BCE</td>
<td>Paleolithic Era</td>
</tr>
<tr>
<td>ca. 4000 - 300 BCE</td>
<td>Jomon</td>
</tr>
<tr>
<td>ca. 900 BCE – 250 AD</td>
<td>Ancient Japan</td>
</tr>
<tr>
<td>250-552</td>
<td>Yayoi</td>
</tr>
<tr>
<td>552-710</td>
<td>Kofun;</td>
</tr>
<tr>
<td>710-794</td>
<td>Classical Japan</td>
</tr>
<tr>
<td>794-1185</td>
<td>Asuka</td>
</tr>
<tr>
<td>1185-1333</td>
<td>Nara</td>
</tr>
<tr>
<td>1333-1336</td>
<td>Heian</td>
</tr>
<tr>
<td>1336-1598</td>
<td>Kamakura</td>
</tr>
<tr>
<td>1336-1573</td>
<td>Kemmu Restoration</td>
</tr>
<tr>
<td>1573-1603</td>
<td>Ashikaga (Muromachi)</td>
</tr>
<tr>
<td>1568-1598</td>
<td>Azuchi - Momoyama</td>
</tr>
<tr>
<td>1600-1867</td>
<td>Unification</td>
</tr>
<tr>
<td>1868-1912</td>
<td>Early Modern Japan</td>
</tr>
<tr>
<td>1912-1926</td>
<td>Tokugawa (Edo)</td>
</tr>
<tr>
<td>1926-1945</td>
<td>Modern Japan</td>
</tr>
<tr>
<td>1945-1989</td>
<td>Meiji</td>
</tr>
<tr>
<td>(1989-present)</td>
<td>Contemporary Japan</td>
</tr>
<tr>
<td></td>
<td>Showa (Pre-war)</td>
</tr>
<tr>
<td></td>
<td>Showa (post-war)</td>
</tr>
<tr>
<td></td>
<td>Heisei Period</td>
</tr>
</tbody>
</table>

*Table A. 2 – The Chronological Timeline of Japanese History*
Ap.3. Comparative Chronological Outline of Chinese, Japanese and other Civilizations

Table A.3 – Comparative Chronological Outline of Chinese, Japanese and other Civilizations
(Shirokauer and Brown 2006)
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