Integration Across Railway

INTEGRATE THE BACKSIDE SURROUNDING OF XI'AN CENTRAL STATION TO THE CITY AS A WHOLE AND TOWARDS THE HISTORIC URBAN CENTER
Integration Across Railway

Integrate the backside surrounding of Xi’an Central Station to the city as a whole and towards the historic urban center

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1.0 Introduction

The aim of this thesis is to improve the central station area in Xi’an, China, by crossing the barrier of railway, the busy road and the city wall, to connect the two sides that having specific identities in different parts.

On the regional level, within the metropolitan delta located in middle of China, a better connection would be promoted by CRH (China Railway Hi-speed system), to decrease the nature barrier of mountains and rivers, and make the delta play a more important role in the country. Xi’an is going to be a main core of metropolitan delta.

And at the mean time, on the city scale, by developing the new district in between, a new mega city is planned for Xi’an and Xianyang (a city next to Xi’an). Depending on this mega vision, the new plan of 2020 is supposed to change the public transport system in Xi’an, and the function and definition of the central train station would be changed after two new train stations and the city metro line built up.

On city scale, depending on the history of urbanization in Xi’an, it shaped a monocentric metropolis situation. Due to the man-made barrier of railway, busy road and city wall, a spatial segregation leads to an unbalanced development in city. The north side of railway has been silenced for a long time until the city government formulated an assignment to make a perspective in order to achieve the strategic goal in mega city in the recent years. A lot of movements are kept on behave for attracting investments and real estate to the north by political methods, which we called top-down politic ambition of “higher, greater and faster” and stronger place identity.

While on the other hand, in neighborhood scale, the backside of the central station is the core place that the problems and contentions occur with the railway, city village, heritage park and hi-dens dwellings. The inhabitants that suffered the social and economical problems caused by spatial segregation for years show the different perspective from the government ambition of “higher, greater and faster”. In a bottom-up condition, a better connection, convenient service for daily life and friendly living environment with place sense is required, but the demolition and Expulsion are the behaviors they expect not to happen.

Depending on the complex situation, this thesis bases on research of Transit-Oriented Development, spatial configuration and place making theory, to give the strategic recommendation and design that can balance the top-down and bottom-up requirements, and focus on a walkable distance from station to neighborhood.
1.1 Metropolitan Background

1.1.1 Location of Xi’an

Xi’an is the capital city of Shaanxi Province, which belongs to the Northwest China. It locates in the middle of China, the geological center point and regarded as the "gate of western China".

There are four metropolitan delta regions in China, while three of them are along the coast. Xi’an, Chengdu and Chongqing formed the fourth delta region as the only one inside the west mainland, which is always the "head leader" of the western China not only in economy, but also in urban development.

1.1.2 Eleven Metropolitan Regions in China

On the other hand, Xi’an and the cities around it also formed a mega region, which is one of the eleven metropolitan regions in China. Except for the three delta regions, mega Xi’an is the only metropolitan region in northwest that is expected to achieve the urban population about 1.6 million in the year 2020.

1.1.3 Economy in Region

On the economy aspect, among overall 33 provinces and executive regions, the GDP of Shaanxi province is ranking at 17 in 2010. Compared with the eastern region, it is far behind, and it is also far behind the neighborhood Henan and Sichuan. Shaanxi took the second place in western China. In such an important location, Shaanxi actually has amount of resources, but what is the reason that it does not develop as good as the other two provinces? Although economy is always influenced by many external factors, infrastructure for network and mobility should be one of it.
1.1.4 Network and Mobility

As mentioned before, the location of Xi’an is very important, which is mainly reflected on the railway system. Xi’an is one of the eight most important rail nodes, and the only node that has the rail lines to all directions, especially to Xinjiang Uyghur Autonomous Rayon and Tibet. It is the only transfer station for the Longhai rail line, the longest rail line in China, that connects the eastern and western China. It is the reason that why Xi’an is called the "gate of western China".

As China is keeping on building the China Rail Highspeed (CRH) system these years, and also some intercity lines are planned to be built in connect the core cities in region. In the strategy of this system, Xi’an will also be an important node, which can be connected to other entire important cities round-trip within a day, called a 24-hour circle of cities. It would decrease the distance in time and bring the city more opportunities in many aspects.

1.1.5 Metropolitan Connection

The metropolitan delta region that consists of Xi’an, Chengdu and Chongqing (one of four Direct-Controlled Municipalities), and another big city called Zhengzhou form a special interface because of the Qin Mountains and Yellow River. The region is a "within-5-hour" economic circle due to the CRH improvement. And the four cities are all typical intensive capital cities of this region, with plenty of cultural activities and universities. The secondary cities around those core cities shows the trend of more compact and efficient in recent years.

However, the Qin Mountains is still an obstacle in interface, the railway tunnels for CRH solved this problem in public transportation, while the highway system for private transport would still take a longer time for travel. This would lead to a result gradually that public transportation especially the CRH would play a more important role in this region.
1.2 Urbanization of Xi'an

1.2.1 Current Area of Xi'an

Xi'an, the capital city of Shaanxi Province, of which the political land area called great Xi'an, is now 10,108km², with 8,434,600 inhabitants spread living in nine urban districts and four counties.

<table>
<thead>
<tr>
<th></th>
<th>Great Xi'an</th>
<th>Urban</th>
<th>Main Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>8,434,600 inh</td>
<td>3,290,000 inh</td>
<td>3,290,000inh</td>
</tr>
<tr>
<td>Area</td>
<td>10,108km²</td>
<td>826km²</td>
<td>490km²</td>
</tr>
<tr>
<td>Density</td>
<td>834.45 inh/km²</td>
<td>3983.05 inh/km²</td>
<td>6714.29inh/km²</td>
</tr>
</tbody>
</table>

Figure 1.2.1: The Land area of Xi'an
Source: diagram made by author
1.2.2 History and Heritage (Antiquity) Spread

The history of the city in the area of Xi’an can be traced back to Zhou Dynasty (1079 B.C.), which is called Fengjing City. And after that, Xi’an was chosen as the capital city for thirteen dynasties, in which Qin, Han, Sui, and Tang were the most famous four. And those great ancient dynasties left several heritages of palaces in this area, current Xi’an city. Most of those historical palaces are now protected as heritage parks, although some of them only have the foundation left. There is no doubt that they are the most important culture resource of the city. The axis of those historical cities also had the great impact to the following years.

Figure 1.2.2: The Land area comparison
Source: diagram made by author

Figure 1.2.3: The History line and heritage location
Source: by author
1.2.3 Urban Body 1800-1949

The big influence of the history is the rules of the city form. Because of the city planning after Qin Dynasty, the form of quadrate in blocks and network continued be used for Xi'an city for thousand years. Before PRC founded, Xi'an almost kept the complete same form of ancient Xi'an. The neighborhoods were compact but with courtyard inside, the local street had nice pedestrian scale and commercial activities along. The main roads were wide but with only bicycle and horses. The city developed slow but more friendly in scale and environment.

1.2.4 Urban Expansion after 1950s

The urban didn't expand much until the year 1980, following the original tessellated system thousand years ago. During this period, the urban fabric of historical center within the city wall was surrounded by the green belt, consists of a circle park along the city wall, has already been kind of icon of Xi'an. The fast growth started from the 1990s, together with the plan of ring road. Before that there was only the first boulevard ringroad outside along the city wall, then the 2nd and 3rd ring road were built as enclosed ring road. It influenced the direction of development in the process.

Before 1980, the urban area mainly concentrated inside the city wall, which had no obvious trend of growing. After that, it started to extend to the south, east and west except north, because of the barrier of railway. Since 1990s, the city started to develop to the north and have several satellite towns in the suburban area.

Figure 1.2.4: The Development of Xi'an after 1950s
Source: diagram made by author
1.2.5 Urban Explosion after 1990s

After 1990, the population and economy grew at an exploded speed; it is extraordinary entering the new millennium. And the tertiary industry obviously grew in a faster speed than secondary and primary industries.

1.2.6 The Mega Plan 2020

In the year 2010, the Chinese government allowed to publish the mega city plan 2020 of Xi'an, with the planning of Xi-xian (Xi'an and Xianyang) new districts. The Xi-xian new Districts is the area between X'ian and Xianyang, which has the Xi'An international airport inside, and it close to the new Xi'an north train station.

This plan shows the potential of the north area, and close behind that is the great encourage from the political power. Because of the mega plan, the interface among the metropolitan area even the northwestern China would be influenced. And in order to match the mega plan, the strategy of main city Xi'an would also changes, the city has the trend to move to north side closer to the new district.
1.3 Research Questions

The main research question of this thesis is:

How to integrate the backside surrounding of Xi'an Central Station to the city as a whole and towards the historic urban center?

In order to answer the main question, the following sub-questions need to be tackled:

- What are the roles of the Xi'an Central Station and its surroundings in regional and metropolitan scale?
  
  **Method**
  - Document study: Urban history, Social background
  - Mapping analysis
  
  **Aim**
  - To understand the characteristics of railway stations and surroundings on different scale levels after the new structure of the public transportation system introduced, and find out the essential spatial-functional design principles for carrying out the roles.

- What are the problem and potential of Xi'an Central Station and its backside?
  
  **Method**
  - Literature study: Spatial configuration, Urban grid
  - Document study: Urban history, Social background
  - Mapping analysis
  - Depthmap
  
  **Aim**
  - To find out the problems and potential of Xi'an Central Station area

- How can the planned new metro project be used in the urban regeneration in the station area?
  
  **Method**
  - Literature study: TOD, Urban grid
  - Mapping analysis
  - Depthmap
  
  **Aim**
  - To find out the principle of TOD that can be used to the surroundings of metro station, include the location of metro station and the connection from metro to train and bus system.
1.3 Research Questions

What is the role of the city village in relation to the historical city center?

**Method**
- Literature study: Spatial configuration, Visual integration,
- Document study: Urban history, Social background
- Mapping analyze
- Depthmap
- Case study: Shenzhen city village regeneration project, Courtyard house regeneration project in Beijing

**Aim**
- Find out the role of city village and its advantage and disadvantage.
- Find out the better way to improve the quality of the current village area, decide to leave or remove it.

How to deal with the image and place identity of Xi'an in the renewal of the station area?

**Method**
- Literature study: Visual integration, Place making
- Document study: Urban history, Social background
- Depthmap
- Case study: Lille TGV train station, King’s cross train station London.

**Aim**
- To make a new define for the station and find out the characteristics of the different parts of the station area.
- Find out the principles of making a place identity of the station area.

How to apply the following design principles into Xi’an station area?

- Network and frame
- Building typology
- Function program

**Method**
- Literature study: TOD, Spatial configuration, Visual integration, Place making
- Excursion and Mapping analyze
- Depthmap

**Aim**
- Give the strategy to integrate Xi’an central Station and surroundings into the local context for short and long term.

How to overcome the barrier of rail, city wall, and busy roads in order to make the area functioning well?

**Method**
- Literature study: TOD, Spatial configuration, Visual integration, Place -making
- Depthmap, visibility analysis
- Case study: Forster Ourense AVE station in Spain, Utrecht Centre station project, Essen Hbf Station
- Design Case

**Aim**
- Find out the most sustainable way to overcome the barrier combined with the current situation.
- Give the brilliant urban design example of the station area.

1.4 Research Objectives

The research is based on the method of "Research and Design" and the "Top-down and Bottom-up system". The main objective of the research is to provide recommendations to integrate the backside surrounding of Xi’an Central Station to the city as a whole and towards the historic urban center. By the design work that is appropriate for local context with a view of Transit-oriented Development and Spatial Configuration.

**Regional scale**
Find the new definition and metropolitan interface of the city Xi’an in the country and region.

**City scale**
Find the reason of inactivity of the north, and integrate the area into the network of city, improve the connectivity of city in local context.

**Neighborhood scale**
Make a friendly neighborhood with “place” sense of street in the station area surroundings that matches the civil requirements and political aims, within a pedestrian and cycling radius.
1.5 Theoretical Framework

![Diagram of theoretical framework]

- **Political Ambitions**
  - International city
  - Metropolitan Area
  - Mega city Planning 2020
- **Urban Design**
  - Eliminate barrier
  - Connection of fragment
  - Reconstruction Net Frame
  - Station Area Identity
  - Friendly Street Space
- **Civil Requirement**
  - Living environment
  - Public Space
  - Spatial connection
  - Friendly neighborhoods
  - Safety
  - Service and Infrastructure
- **Theory Study**
  - Virtual Integration
  - Spatial Configuration
  - TOD-Oriented Development
  - Depthmap Test
  - Urban Grid

1.6 Thesis Structure

![Diagram of thesis structure]

- **Context and Background**
- **Preliminary Analysis**
- **Problem Statement**
- **Research Question**
- **Research Investigation**
  - Specific Research
    - Public space
    - Living environment
    - Civil requirement
  - Book Review
    - Document Review
    - Data Collection
    - Mapping
    - Morphology
- **Analysis Research**
  - TOD development
  - Urban regeneration
  - Sustainable urban
- **Strategy**
  - Inner city regeneration
  - Network reconstruction
  - New definition
- **Case & Comparison**
  - Public transportation node
  - TOD regeneration
  - Public space design
- **Project Design**
  - Suggest design principles
  - Solutions in detail
- **Design Evaluation**
  - Tool Box
1.7 Methodology

In this thesis, the main method is "research and design" and "top-down and bottom-up approach". For detail, I will use four methods to finish my research and achieve the goals. They are depthmap, urban grid, case study and literature review.

Depthmap and urban grid are based on the idea of spatial configuration theory Hillier (1993). The case study will give some good examples and suggestions while planning and design. Literature review would concentrate on the theory of Transit-Oriented Development and urban regeneration.

The methods are close related to the centralities of design, and finally under the frame of three theories, they are Spatial Configuration, Transit-Oriented Development, Visual Integration and Place Making.

I will give the brief introduction for the method of Depthmap and Urban Grid in the following pages.

![Main Method Diagram](image)

**Depthmap**

Depthmap is a single software platform to perform a set of spatial network analysis designed to understand social processes within the build environment. The original concept behind Depthmap developed from two strands of thought. One was isovist analysis (Benedikt, 1979), and the other was space syntax (Hiller and Hamson, 1984). It consists of several analyze tools, ranking in varied scales from building, neighborhood and whole region even states. The main tools used in thesis thesis are "axial map", "segment map".

The axial map shows the degree of street integrating to other streets, and it represents the space for movement, it is a strong predictor of pedestrian and traffic flow rates (Akkelies van Nes, 2009). The segment map shows the degree of vitality of the street. Under the segment map, topological and metrical analysis shows the pedestrian based economic activities in urban centers.

- Depend on potential movement patterns
- Metric and topologically centrality of streets
- High degree of connectivity to the vicinity (high number of axial lines in an area)

Under the idea of depthmap, the relation between spatial configuration, movement and attractors are also important. It shows the sustainable circle, which is one of the basic ideas in space syntax.

In this thesis, it will be used as the main method of analysis, design and evaluation.
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A Study of TOD on the Regeneration in Historical City Center
Under the Background of High-speed Expanding Cities in China
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Graduation Lab Urbanism Conference
Jan 12th 2012

Abstract – This paper discusses the Transit-Oriented Development used in the process of regenerating the historical center, based on the research of the development and the achievements in TOD of different cities in the past twenty years. The TOD has already showed the potential in regenerating historical centers. But considering the facts of Chinese cities that under high-speed expanding, it is anticipated to promote some integrated thinking of the TOD in regenerating a historical city center, which is suitable to the scale and form of the old urban fabric in this paper.

Transit Oriented Development (TOD) is a mode mixed-use residential or commercial area designed to maximize access to the public transport, and often incorporates features to encourage transit ridership. Transit-oriented development based on transit system, help improve efficiency of land use and transit operations in neighborhood in different areas of city and make them work together. While over the past decade, in most of the developing countries, the cities are facing huge problems on regeneration in the historical city center. The confliction between the worth of historical city center and the demanding of rapidly urbanization arise in many aspects.

Key words – Transit-Oriented Development; historical city center; transformation; spatial reconstruction; public transportation; connection.

1 Introduction
In almost all the developing countries, cities are growing in a rapid speed of urbanization. Because of the high density in the old city center, the requirements of urban expansion, or the new definitions for the urban, many historical cities choose to build new districts instead of demolishing or rebuilding the old center. This is a period that a city experiences a great revolution on its form, which is also a big transformation.

Mostly, the historical city center, which is limited by its form and scale, has several problems. For example, the traffic jam during a rush hour, the confliction between high land price and low living quality, the lack of public spaces and living spaces, and the huge area of protected heritage buildings. While during the transformation period, some of the main functions will move out of the historical center, such as the local government, social service organizations, business companies and train stations. Those changes mentioned above will bring several influences to the city and its residents. It can be a challenge that the old center may lose its life, while it can also be a chance to solve the problems in old center by reconstruction.

There are several Chinese cites, especially those historical cities, keeping expanding in a high-speed determined by the top-down politic system; while in the high land price area of the historical center, urban fabrics are not constructed in an efficient way. There is an emergency that those Chinese cities should find a way to regenerate the historical city centers to solve these problems.

Transit Oriented Development (TOD) is a mode mixed-use residential or commercial area designed to maximize access to the public transport, and often incorporates features to encourage transit ridership. Transit-oriented development first put forward by Peter Calthorpe in 1993. It is the reflection of the Neo-traditional Planning, which is trying to get of the “pure” functional planning in space, achieve a balance in a diversity of both functions and residents in space. Based on the experiences in North America and Europe, and the achievements of successful cases such as Rosslyn-Ballston corridor in Arlington, the TOD emphasizes the organization of open space by a public transportation. The public transportation including railway, subway, light-rail, tramline and bus lines,
Integration Across Railway

A Study of TOD on the Regeneration in Historical City Center

Li Lu

In the year 1993, Peter Calthorpe put forward a new planning idea different from the old rules as follow:

i. The direction of growth in region should be the same as the public transportation, which can be more compact in frame.

ii. The “pure” functional zoning rules can be replaced by the multiple, diverse and mixed-use walkable rules in planning.

iii. The urban design should focus on the public open space that follow the scale of people, but not the scale of autos and private space.

In this new idea, TOD was one of the most important tools being widely used all around the world in different levels such as regional planning, community planning, and urban design. 1

2.2 The core idea and elements in TOD planning theory

In general, there is not a clear definition of TOD; different local agencies always have their own definitions adapted to local situation. Most of the definitions related to smart-growth and sustainability principles emphasized the importance of high-quality pedestrian environment, and the mixed land use in a compact context. The agreement of how to constitute a TOD is the pattern of dense, diverse, pedestrian-friendly lands uses near transit nodes under the tight conditions.

The common elements of a TOD mode have been concluded as follow:

- The compact and mixed land use
- The well-developed public transport service around
- The exploitation of land that can help to increase the usage of public transportation
- High-quality in pedestrian and cycling environment
- Public open space and infrastructure close to the traffic node
- Traffic node related to the center of area

In this new idea, TOD is providing a neighborhood living and working environment. TOD mode and the transportation and investment, a better mode of development for accessibility and mobilities was advanced, which aims to achieve a contribution in area in a high efficiency. Based on this, different from the Suburban Sprawl mode, a concept of Neo-urbanism was put forward. It advocates a “diverse, mixed-use” projects, to created a kind of “compact, vibrant and walkable” community, which emphasis on the relation between public transport service and the land use.

A typical TOD consists of the following elements: public traffic node; commercial core; office area; open space; residential area and secondary area.

Table 2.1 The Basic Configuration of “TOD”

<table>
<thead>
<tr>
<th>Relation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public traffic</td>
<td>The center of TOD</td>
</tr>
<tr>
<td>node</td>
<td>Convenient in mobility</td>
</tr>
<tr>
<td>Commercial area</td>
<td>Neighboring</td>
</tr>
<tr>
<td></td>
<td>Strong attraction; Round-the-clock</td>
</tr>
<tr>
<td></td>
<td>public center</td>
</tr>
<tr>
<td>Offer area</td>
<td>Neighborhood</td>
</tr>
<tr>
<td></td>
<td>Reduce the commute pressure;</td>
</tr>
<tr>
<td></td>
<td>Job-housing balance;</td>
</tr>
<tr>
<td></td>
<td>Encourage using public transportation</td>
</tr>
<tr>
<td>Open space</td>
<td>Center; Around by other function</td>
</tr>
<tr>
<td></td>
<td>Provide space for communication</td>
</tr>
<tr>
<td>Residential area</td>
<td>Neighborhood</td>
</tr>
<tr>
<td></td>
<td>Reduce the commute pressure;</td>
</tr>
<tr>
<td></td>
<td>Job-housing balance;</td>
</tr>
<tr>
<td></td>
<td>Encourage using public transportation</td>
</tr>
<tr>
<td>Secondary area</td>
<td>Outside area</td>
</tr>
<tr>
<td></td>
<td>Not necessary;</td>
</tr>
<tr>
<td></td>
<td>Cannot compete with the inside area</td>
</tr>
</tbody>
</table>

According to the top 5 in U.S., the general goals of TOD are increasing ridership; financial in nature (promoting economic development and job growth and raising revenues for transit properties); raise revenues; enhance livability; and widen housing choices.

TOD, as one of the more visible forms of smart growth, is increasingly viewed as an antidote to traffic congestion, the isolation and detachment felt in many suburban communities, affordable housing shortages, and inner-city decline and disinvestment. 3

TOD can spur the redevelopment of declining neighborhoods (e.g., downtown Long Beach, California, and Arlington Heights, Illinois), spawned new suburban villages (e.g., Pleasant Hill, California, and Orenco, Oregon), breathe life into older suburban downtowns (e.g., Bethesda, Maryland, and Plano, Texas), and speed up the transition of places suffering from slow commercial encroachment (e.g., Ballston, Virginia, and Rutherford, New Jersey). 4

In fact, TOD is providing a neighborhood living with a better quality, the life style mainly by walk, bike and public transport but less drive to reduce stress, and encourage one to meet neighbors can offer a safer living environment. The word “livability” means clean air and water, safe streets, positive relations, affordable homes, quality green open space, public education, uncongested road, and low taxes when residents mention it.

2 The overview of TOD development

2.1 The brief history of TOD development

Transit Oriented Development (TOD) is a mode of compact mixed-use residential or commercial area designed to maximize access to public transport, and often incorporates features to encourage transit ridership, first put forward by Peter Calthorpe in 1993.

At the end of the 20th century, two trends of “Comebacks” occurred in North American cities. One trend is that people began to come back to inner city, together with the investments, which made the city center regarded as an ideal place to live ever than any other periods after the World War II. Another one is that the attention was paid to the rail transport than the highway system, so planning in city rail or public transport system kept on growing. It is the first time that the growth of public transportation usage had exceeded the growth of private transportation after the World War II. The compact mixed-use projects in walkable area around amount of public transportation stops revived the center to be active, which leads to a new attention to the public transit oriented in lots of American cities.

As we all know, since the wide usage of private car in the United States in the 1920s, the centrifugal trend was showed in commerce, industry, and society group (race, economical class etc.). The Auto-oriented Development and urban sprawl leaned to a low-density landuse and “country on wheels” as the symbol of the American Dream, which mainly rely on the auto instead of public transport.

But because of the crisis on energy, environment, and the pressure from transportation and investment, a better mode of development for accessibility and mobilities was advanced, which aims to achieve a contribution in area in a high efficiency. Based on this, different from the Suburban Sprawl mode, a concept of Neo-urbanism was put forward. It advocates a “diverse, mixed-use” projects, to created a kind of “compact, vibrant and walkable” community, which emphasis on the relation between public transport service and the land use.

Urban Design should focus on the public open space and infrastructure close to the traffic node.
2.3 Cases and learning

For the history of TOD experiences in North America and Europe, it is necessary to learn from cases. Four typical cases, Boston, Portland, Copenhagen and Chicago, are chosen to explain the process of a successful TOD plan, and the influence of a TOD plan from different aspects.

2.3.1 Boston

Boston is a city that grew up around public transportation. For Boston, TOD was once the only type of development. Most of the longstanding buildings and neighborhood were planned closed to the trolley and interurban lines made the Boston core a strong character of TOD. TOD in this city is about the way the city has tried to take back its old neighborhood character without sacrificing modernity and mobility. The challenge is how to provide diversity in service that can match the needs of the modern business and upscale residents accustomed to a larger space.

Methods

• Commuter-rail lines, new rolling stock
• Fringe the number of allocated spaces at 1973 levels
• MBTA stations without parking
• Putting pedestrian accessibility above automobile convenience
• Neighborhoods characterized by pedestrian orientation interwoven of business, retail and residential buildings at high densities
• Close access to public transportation

Lessons

• Strong market makes things work
• Strong public-sector leadership is needed to promote TOD
• Significant part of leadership helping to make projects work financially
• Transit is a lynchpin in a more sustainable urban regeneration.

2.3.2 Portland

Portland’s experiences with TOD have evolved over 25 years, from being largely an afterthought to becoming one of the primary considerations in rail facility planning. In Portland, TOD has become a part of the Regional Policy Framework, which was comprehensive growth management at a community and regional scale. The greatest attention to TOD is focused on the stations of the Portland Streetcar and the region’s three light-rail lines. The projects included the Cascade Station, Sunnyside Village, Lexington Park, Richmond Place, The Yards at Union Station, are successful and worth to learn from.

The core objective and conclusion of the Portland case in TOD are concluded below (see Table 2.4).


2.3.3 Copenhagen

Copenhagen was successful in urban frame because of its famous “finger plan”, which promoted several corridors connecting to the core centre in region. TOD, as a method, combined metro lines along the corridor with service, business and dwelling around the station in suburban; and combine the public transportation with pedestrian and cycling together at the same time.

Meanwhile, the policy of control in private auto transportation makes Copenhagen a typical case in TOD that mainly relies on the public transportation. The methods and lessons of the Copenhagen case in TOD are concluded below (see Table 2.5).

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Lessons

• Strong market makes things work
• Strong public-sector leadership is needed to promote TOD
• Significant part of leadership helping to make projects work financially
• Transit is a lynchpin in a more sustainable urban regeneration.

2.3.2 Portland

Portland’s experiences with TOD have evolved over 25 years, from being largely an afterthought to becoming one of the primary considerations in rail facility planning. In Portland, TOD has become a part of the Regional Policy Framework, which was comprehensive growth management at a community and regional scale. The greatest attention to TOD is focused on the stations of the Portland Streetcar and the region’s three light-rail lines. The projects included the Cascade Station, Sunnyside Village, Lexington Park, Richmond Place, The Yards at Union Station, are successful and worth to learn from.

The core objective and conclusion of the Portland case in TOD are concluded below (see Table 2.4).


2.3.3 Copenhagen

Copenhagen was successful in urban frame because of its famous “finger plan”, which promoted several corridors connecting to the core centre in region. TOD, as a method, combined metro lines along the corridor with service, business and dwelling around the station in suburban; and combine the public transportation with pedestrian and cycling together at the same time.

Meanwhile, the policy of control in private auto transportation makes Copenhagen a typical case in TOD that mainly relies on the public transportation. The methods and lessons of the Copenhagen case in TOD are concluded below (see Table 2.5).
2.3.4 Chicago

The case of Chicago is about a few communities that have the resources, initiative, and leadership to tap into the market for compact walkable development around transit.

TOD is on the rebound in suburban Chicago, there was a growing number of communities along Chicago’s Metra commuter-rail line that use TOD as a part of a conscious strategy to reinvest in and revitalize suburban centers. The tools and conclusion of the Chicago case in TOD are concluded below (see Table 2.5).

Table 2.5 The Case Study of Copenhagen

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Method</th>
<th>Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOD plan in Region, promoting the connection with inner city; Controlling of private auto transportation.</td>
<td>All fingers connect with the inner city, maintain and strength the transit function of inner city; Limit the auto growth by reduce parking area, drive the city by bike and public transport; Recommendations of all the project's development concentrate around the public station, within 1km; High density around the stations; Consoromated pedestrian and cycling infrastructures, and hubs for transfer in public transport, change some of auto roads and parking into cycling.</td>
<td>Activities in city should be considered in a regional scale, so as TOD planning, a neighborhood planning would cannot change the landuse and transport mode, which would not benefit as much as expected. Public rail transport and the land use can supplement each other by a positive cycle, which promote the TOD moving forward. Street is a place not only for transportation, but also for daily activities.</td>
</tr>
</tbody>
</table>

3 The study of historical city center

3.1 The characteristics of historical city centre

The historical city center, especially in some of the cities with long histories, served the cities as the center of trade, living and entertainments for centuries. It was described as a “vibrant, closely, interlinked component of its new, enlarged form, performing an essential and distinctive socio-economic role in daily life of its citizens” (Giovannoni, 1998).

3.2 Conclusion

TOD planning is a way to improve the relationship among the “increasing transit ridership”, “Maintaining landuse equity” and “enhancing living quality”. And based on these, TOD also forms a new cycle of the landuse and traffic system, which can be regarded as a natural-sustainable cycle. It is a method that can be used in all those area that need a sustainable urban design based on the traffic system, and help those to form a new structure of region and neighborhoods.

For the historical city center represents the past of the city, normally it has the cultural significance concealed in the buildings and places by shape, size and local form. It carries two essential qualities: “the socio-cultural values that signify the role in defining sense of place, community belonging and social cohesion and the environmental capital that is represented by its buildings and urban infrastructure” (Rodwell, 2007).

Most of the historical city centers showed their socio-cultural values through (heritage) buildings, which represent the past, present and future. It is the foundation of present, the way citizens treat them reflects the view of a city, which will effect the future generation.

In addition, the (heritage) buildings and so-called places in historical city center related to a collective memory between generations. The memory of a friendly living environment and life style cannot be separated from the body of buildings and places. In another word, it had become a part of our lives. There are five reasons of the importance of the historical center preservation promoted by Stripes (1983).

On the other hand, the historical city center also has the irreplaceable value in economic aspects. As Porter (1995) described that the four elements of the historical city center can be regarded as the advantages. The strategic location of historical city center at least used to be the most valuable areas in a city, which related to flourishing commerce, busy traffic nodes, administrative center and compact living. The Local market demand shows the most integrated area and streets in a natural way itself, even though the other markets saturated. Integration with regional clusters, the more compact the historical city center and integrate the network are, the stronger competitiveness in economic the area would have. Human resources, the local residents in historical city center are more likely to be poorer than other parts in city, they are more eager to have...
a nicer work with better income to support an improvement of living quality.

3.3 The special facts of historical city centre in Chinese cities
Different from other developing countries, China has its own background that brings more challenges for those cities with long histories. With the new perceptions with modernization brought in, the civil view of value, life, and history were evolved gradually. Both the government and people have the eagerness to chase a high-speed development, which leads to a rapid expanding in urbanism, and the fragments of traditional urban fabric in both social and spatial aspects.

Meanwhile, within the top-down politic system aiming on rapid development, some of the confrontations mentioned previously become worse. The fast shift in urban function reflects more problems in the most compact area of historical city center. The specialist facts in most of Chinese cities' historical city center are the conflict between “preservation” and “renewing”, where the “renewing” was understood as demolish and rebuild. Apparently, some riots happen during the illegitimate urban demolish program, the low income residents are not willing to leave their houses, while high incomes migrate to suburban for higher quality, the identity of culture and history is no longer alive, and the pressure of infrastructure such as sanitation and transportation become higher. On one side, the pressure from urbanization and renewing demands for the improvement of living quality, environment, infrastructure, service and structure work. It is emergent to be taken into consider to fit the civil need and development in economy.

On the other side, from the culture aspect, cities ask for memory of history to be alive and keep the city brand, seen as the identity of historical city center. That means the historical city centers need to be regarded in a different way from other districts, the fabric such as streets, buildings, spaces and residents in a traditional scale would be the character.

The conflict always happens in Chinese cities because it is hard to find a balance between the two sides.

3.4 Conclusions
For the importance of historical city centers, and the threats that it faces during the urbanization process, the cities that in the special Chinese conditions need to find a way while regenerating their historical city centers.

In addition, the theory of relationships among the spatial configuration, attraction activities, and human movements that Hillier (1993) stated is also a support for the suggestion of a sustainable cycle in regeneration. It argues that, attracts and movement would influence each other, but they may not influence the spatial configuration, which describe its spatial location. It reflects that the space is nothing if there is no human activity to give the meaning. For historical city center, the regeneration should take the relationship in consider, regard human activity as an important element. The natural movement encouragement could be the appropriate solution in the conservation strategy towards a sustainable development.

As a conclusion, there are some rules during the regeneration in Chinese historical city center:
- Combine the regeneration planning with the planning of new districts. Consider the city as a whole, none area could be developed independently, and the movement in one will always have influence on other.
- "Preservation" and "renewing" are not two opposite processes. How to fit the new requirements and protect the traditional value is the most important topic.
- The improvement in urban fabric would not show the successful outcome at once, it is a long process.
- Mostly, regeneration in a compact historical city center is a subduction and shifting, aiming to provide more services and public spaces within a friendly scale.
- Notice the impact of human activity; make use of the relationship among attraction, spatial configuration and movement to reform the structure and environment of historical city center.
Moreover, at the same time, TOD is based on a center traffic node, which can be a railway station, a historical city centers. TOD can bring the historical area the transformation commercial core, open spaces, and residential area, metro station, a transfer station, or a bus station. Control is to reduce the parking space near the node, addition, in the methods of TOD, the most useful reasons, by avoiding driving too far to work. In influence the area that has no needs to demolish in function and structure around the traffic nodes, and pedestrian environment. This is a point to provide better service atmosphere, public spaces most of the historical buildings, and would form an environment that TOD suppose to achieve. For goals of friendly pedestrian and cycling attractive and sustainable cycle to revive the traditional culture of "share", in the forms of so-called mixed-use buildings. Secondly, the tradition in culture, life style and development in historical city center under the Chinese regeneration after analysis, give a clear spatial suggestion, and the future view. Therefore, the optimization of these two approaches should be anticipated in the attempts of regeneration in historical city center under the Chinese background to achieve a sustainable result.

6 Bibliography

2.1 City-Net of Xi’an

2.1.1 monocentric metropolis situation

During the period of fast expansion that the city is experiencing, several satellite centers are planned to be connected better to the old city center, which has remained to be a symbol of center for the city inside the city wall for thousand years. Some of those satellite centers are those existing small towns that undertake new functions have particularly important relationship to the to the main city, some of those are new planned centerz concerned about the resources and balance of city form. Leading by the ambitious of mega city plan 2020, in order to build the connection and new district between Xi’an and Xianyang, the new development and concentrate would absolutely develop towards the riverside in north. The connection from the main center to all satellite centers, infrastructure axis, are demanded to be expedited.
2.1.1.2 Attraction and Activity

Following the theory of spatial configuration, the attraction, spatial configuration and movement have the links that the attractors and natural movement would influence each other as a sustainable cycle, and mostly the attractors are reflected in commerce. Then the natural attraction and activities of the city can be explained by the analysis of the location of the commercial area.

At present, the settlement of commerce in the city centralized in middle, where the main cross inside the wall attracts movements from all directions in the city; while several commercial centers in the south also formed a strong atmosphere. All of the existing commerce centers are located along the axis extended from the main cross in the center.

While in order to achieve a balance and be closer to the new district in the metropolitan scale, the proposed guide of movement in the north has been taken considered by the government, to create more attractions after the power guiding.

Because of the top-down political system in China, the government building and service organizations always become the crowd places in city. It is not difficult for the government to start to guide the movement to the north on strategic level under the power of regime. At the beginning of 2011, the city hall moved to the north from the inner city, while the provincial is still inside the city wall. It is an efficient method to guide the investments and “unnatural” movement to activate a new area. However, on the other hand, the separation of service organization and the two power buildings makes the connection from inner city to the north more important than ever.
2.1.2 Transport Infrastructure Inside City

2.1.2.1 Rail System
According to the passenger number in all public transportations, the number of people travelling by train still keeps growing until 2009. Since the CRH rail lines will continue to build in 10 years, it is not hard to conjecture that the figure will increase more afterwards. There used to be only one train station in Xi’an, as the central station. For the requirement of CRH rail lines, the old central station can no longer take the pressure of such a frequency of trains. So a new station, north train station has been opened up since 2011 in order to take over all the CRH lines (mainly concerned on business and commuters) and some Tourist train lines in the future. Meanwhile, in the coming years, the south station will be reconstructed to a bigger one, for the short lines with neighbor provinces. Once the new system of stations settled, all the stations would have different roles. The central station will mainly take the long lines to Sinjiang and Tibet, the north station will have most of the CRH, and the south station will be the station for city lines. The pie chart shows the passenger proportion of different stations in the year 2011 and proposed in forecast year 2020. It is an opportunity that the new stations sharesome of the pressure for the central station, and redefine the role of it. The definition is that passengers through central station would most be travelling for vacation or homeback, and the first impression of the station would form the identity of Xi’an in most of the traveller’s eyes.

2.1.2.2 Airport and Metro
As introduced in the first part, according to the urbanization history of the city, Xi’an was sprawling towards south in the past. And the mega plan 2020 shows the potential of north where the metropolitan connection, new district, city hall, and airport will locate.
Since September 2011, the first metro line has been opened to the public in Xi’an. The introduction of the new metro lines will help to reduce the pressure of transportation in the crowded inner city and south area, and integrate the connection to north.

2.1.2.3 Public Transport Node
The new structure of public transport infrastructure would be the opportunity to connect the fragments and make the main urban area more compact. The big transfer nodes would be those places where most attraction and activities happen. In the limited urban area of north, the northeast side that is close to the railway would become more convenient by the public transportation.
2.1.2.4 Road System

The basic idea of the road system is clear: encircled by three ring roads in middle, and several axes to all directions around. Approximately speaking, it is connective in urban area. But for technical analysis, space syntax is needed.

Space Syntax Analysis of Road System

Space syntax is one of the main methods used in this thesis. It is a theory on the city network and space form.

Integration

This image shows the global integration of network global level (R=n)
North: Less integrated
South: Inner city until 2nd ring, the most integrated area
North Station (New): Low global integrated position
Central Station (old): End of one most important avenue that is high integrated

This image shows the global integration of network local level (R=3)
North: Less integrated but with clear grid
South: Inner city until 2nd ring, the most integrated area
North Station (New): Better than global level
Central Station (old): Less important than global level
**Topological Choice**

This image shows vital roads for strangers on local walking movement level. On pedestrian scale, the people who are not familiar with this city used to walk inside inner city and the south area where some activities might exist mostly. Both the two station areas are not so welcomed somehow.

**Metric Total Depth (R=10)**

This image shows urban hot area on short distance walking movement level. Similar result as the topological choice, but the south and the west inner city are more crowded. The Center station in the cross point of two hot area axes has the great potential to develop the pedestrian environment both in both sides (north & south).

**Node Count**

The node count is the number of segments encountered on the route from the current segment to all others.

On the local scale, it is mainly concentrated in big cross close to south.

On a high scale, the inner city and south area are better than other places.
**Metric Choice**

The metric choice ratio in 10, 50, and 90 represents urban hot areas on short distance pedestrian level, cycling level, and automobile level.

It is obviously that the faster the travelling method, the wider road it would demand. And for the friendly pedestrian scale, the local street would be more important.

For walking movement, the most integrated area with plenty of narrow paths would be the best choice, which concentrated in the south and west area of city.

While for the cycling and auto movement, the ring road would play a more important role.

**Connectivity**

North: Lack of connection
South: Connective and centralized
North Station: New area, connective but not compact
Central Station: Direct connection to center and south, no connection to north
2.1.3 Conclusion

While the city is developing in a monocentric situation that the attractions and movements are guiding to the north to achieve a balance and connection with new district in future, the space syntax analysis shows that most areas in the north cannot be integrated to the city as a whole at present. At the meantime, the big revolution in transport infrastructure inside city brings a favorable turn. The new structure of rail system changes the roles in different stations. Metro is an opportunity that can not only connect those important cores (such as airport, train stations, commercial centers, city hall, and public parks), but also wake those inactive areas around stations in pedestrian scale by a reasonable urban plan.

However, the problem is, what kind of plans could make the place attractive for the natural movement of people, in order to active those areas? Considering the condition of the infrastructure in Xi’an and the literature review I did, Transit-Oriented Development can be used as a good method for planners.

2.2 Problem of Barrier

2.2.1 Triplex Barrier

For the monocentric metropolis situation, the uneven development is the result of spatial segregation, mainly caused by the railway, busy road and the city wall. The urban developed with the barrier as the diagram shows. At first, the railway and train station came close to the historical center, and then urban expanded from center to all directions but the station area. At last, it formed the undeveloped backside area. The “man-made” barrier of rail, road and wall stops the connection from the eastern inner city to the north area, and the only connection is intercross of main roads. It not only makes the area isolated in space, but also leads social and economical problems.
2.2.2 Space Syntax Analysis

The Integration maps show the area lack of integration, the local the scale is, the less integration the north area would be. It means that the backside of station is not integrated in a walkable distance at all; the network structure and scale is not suitable for pedestrian.

Topological Choice maps show vital roads for strangers in scale of walking movement (R=10) and automobile movement (R=90). The station backside area is the place that people, who are not familiar with the city, hardly visit.
2.2.3 Segregation in Urban Quality

As the residents reflect, they are not satisfied with segregation of living quality on two sides of the barrier. Local residents called the north side "Daobei", a name refers to "slums, dirty, and unsafety place". The social and economical problems caused by spatial segregation are as follows:
- No visibility and movement in zone.
  In past years, the function of north side is mainly warehousing; citizens live elsewhere have no reason to visit this area, although it is extremely close to the inner city.
- Security problem.
  Because of the train station and the industrial function, most of residents by the north of the railway are floating population. This is the reason of slums, and keeps in high crime rates all the time.
- Ineffective land use and environment problem.
  In such an area that lacks of services and infrastructure like this, the land is not planned in an effective and integrated way.

From the activities of commerce (retail, restaurant and hotel), the great contrast is expressed. Totally different from the inner city, activities mainly along the three axes roads in the north, the minor roads are in silence.

After introducing the metro, the situation will intensify in the main road. It is said that the barrier not only cut the connection between zones, but also the movement within north zone.
2.3 Backside of Station

2.3.1 Current Situation of Space Quality

A. Open space in north

B. Main body of heritage park

C. Open space in south

D. City village close to railway

Images 2.3.1: Current space quality analysis
Source: By author
2.3.2 Current Situation of Network

Figure 2.3.2: Current Network mapping
Source: By author

Integration Across Railway Complex City / Li Lu / June 2012

Images 2.3.2: Current Network situation
Source: By author
2.3.3 Confliction of Top-down and Bottom-up system

As the top-down political system in China, governments always have some great ambitions, such as a big empty square, high-rise buildings, and huge landscape or heritage parks that are not open to citizens for free. The government is also planning to do such a kind of “great design” in the backside area. While during this process, some confictions will be difficult to avoid, for example the demolishing and expel of the original inhabitants. The ambition will totally change the urban fabric into a too great scale. And considering the area is so close to the historical inner city, the decision needs to be rethought.

On the other hand, good urban design demands for a bottom-up research and consideration. Depending on the civil requirement of inhabitants, what they want is not a “great land”, but a friendly, convenient living environment with a higher quality. For example, streets have ‘place’ sense in pedestrian scale could be the place that stories happen, traditional courtyard house and well-known neighborhood make city life colorful, green space and infrastructures provide a convenient and happy mood. Another important fact is that, most of original inhabitants are not willing to leave “their home” by forced evacuation. The confliction between the top-down and bottom-up is on the edge, and a balance point needs to be found out in the design process afterwards.

2.3.4 Conclusion

After a serious analysis on the backside area of Xi’an Central Station, a SWOT is needed for the conclusion as the analysis part. The following SWOT diagram gives a start point for the following research and design work.

- Located close to the central station
- Heritage Park provides a symbol of culture in the city
- Good service system in education, medical treatment, and cultural aspect.
- Good connection inside the city village in pedestrian environment
- City village is a part of the urban memory

- Big chance of Metro
- New define of station
- Empty space around the huge heritage plaza

- The barrier of the railway, unreachable inner city
- Lack of walkable connectivity pass the heritage park
- Low quality of the environment
- No attractions empty and quiet in park
- Unfriendly road profiles

2.4 Strategic Goal

The strategic goal is to achieve a new interface from the metropolitan region to the local scale. A new minor center close to the central station is expected to be shaped, help to overcross the barrier of railway and wake up the inactive backside area. A friendly neighborhood in pedestrian scale driven by the double public transport infrastructure would be gained in design process under the guideline of Transit-Oriented Development.

- Active backside area
- Double traffic centers driven by TOD
- Pedestrian environment
3.1 Theory Study and Conclusion

3.1.1 Transit-Oriented Development

Transit-Oriented Development (TOD) is a mode of residential or commercial mixed-use area planned to maximize access to the public transport. It often incorporates features to encourage transit ridership, first put forward by Peter Calthorpe in 1993. The theory and successful cases of it can provide the principles for this thesis, especially the design part. The literature review in 1.8(see page 27) discussed the theory of TOD, includes the cases and relation between TOD and urban regeneration.

### Table 3.1: The Basic Configuration of "TOD"

<table>
<thead>
<tr>
<th>Relation</th>
<th>Features</th>
<th>3.1 Theory Study and Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public traffic node</td>
<td>The center of TOD</td>
<td>Congestion in mobility</td>
</tr>
<tr>
<td>Commercial core</td>
<td>Nearby, Combined, $&lt;$ neighborhood $&gt;$</td>
<td>String-striction, Round-the-clock public transit</td>
</tr>
<tr>
<td>Office area</td>
<td>Neighborhood</td>
<td>Reduce the commute pressure, job-housing balance, Encourage using public transportation</td>
</tr>
<tr>
<td>Open space</td>
<td>Center: Access by other function</td>
<td>Provide space for communication</td>
</tr>
<tr>
<td>Residential area</td>
<td>$&lt;$ neighborhood $&gt;$</td>
<td>Reduce the commute pressure, job-housing balance, Encourage using public transportation</td>
</tr>
<tr>
<td>Secondary area</td>
<td>Outer around</td>
<td>Not necessary, Can use the inside area</td>
</tr>
</tbody>
</table>

Source: See Literature Review
3.1.2 Spatial Configuration

The distortion of the theory of the natural movement economic process.

Isovist is an architectural term meaning the area within people’s field of view. As an illustration of the figure besides, we assume the 4 white blocks as buildings or solid pattern in urban context from a view of plan. The calculated outcome of all line analysis shows all the isovist lines and implies which the highest integrated line is. Basing on this essential knowledge, Depthmap could get a visual integration map for such a case.

Conclusion: Better visual integration at X-junction than T-junction

The right side urban grid could be imagined as a comparison of a homogenous low road mesh density city and another grown up city which has a high dense road downtown area and surrounded by low dense grid. Manifestly, after a denser core area coming up, the vitality of the road changed a lot. We could conclude that the main road passing through the high dense city core would be more intensive on the aspect of visual analysis.

Better visual integration at junction point, which situated at the intersection of two roads besides more dense (density of road mesh) area; Local dense area might be less integrated on visual aspect.
Practical Conclusion as Further Design Principle:
1. In order to make a road more integrated, the best approach is enabling it to be crossed as dense meshes as possible. X-junction works better than T-junction.
2. In order to situate a transit node at a most visual integrated point, the best approach is locating it at the intersection of two higher level roads which are high configurative integrated. Public open space is indispensable.
3. Dense stops could be arranged in high vitality urban area to decrease the auto traffic. Correspondingly, the dense urban grid appearing, especially the lower level ones could release the traffic pressure as well. The radius controls each respectively from local to global.

According to Stephen Marshall’s book, the total of continuity, connectivity and depth ratio show the characteristic of network.
Continuity is taken as the number of links that route is made up of, or the length of a route measured in links. The label ‘continuity’ reflects how many junctions a route is continuous through.
Connectivity is taken as the number of routes with which a given route connects. Connectivity reflects both the number and modality of joints along a route.
Depth measures how distant a route is from a particular ‘datum’, measured in number of steps of adjacency. The more steps distant a route is from the datum, the ‘deeper’ it is; the fewer steps distant, the ‘shallower’.
The test is about the difference between the two conditions in Xi’an train station area, current condition and the condition after test improvement of extension of several street and two tunnels cross the railway. I selected 12 main routes in account, which are the main roads of the area.

As we can see that after changing, the total figure in continuity ratio and depth ratio decreased and the connectivity ratio increased a little. It means that the network afterwards shows a stronger character of connectivity.
However, the changes in figure are little, which also reflects that the area is too big to be valued, and it will be more obvious if I value it in a smaller scale.
According to the theory, more cell-ratio and more X-Ratio could help an area become more accessible and connected. Applying this method to count the number, the ratio and relation are shown in the chart. The results show that by extending several routes, the north area become more accessible and connected. It can be used as the basic frame and principle for the next step of design.
3.1.4 Place making

After the frame of the backside area settled down following the former theories, ‘place identity’ needs to be added to the environment. Therefore, some specific design principles for the walking movements need to be found out. Fortunately, another master thesis has already done some study and conclusions on this theory, depending on studying Jan Gehl’s literature focused on improving the quality of urban life by re-orienting city design towards the pedestrian and cyclist scale.

“In his book New City Life, he uses 12 key quality criteria to evaluate selected city spaces. Furthermore described by the book, the reality shows that those city spaces meeting most quality requirements are also the most popular and well-visited sites in the city conversely, the city spaces that meet few or next to no quality criteria are those least utilized.” (Ran Hu, 2010)

3.2 Case Study and Comparison/ Example Of Good Practice

3.2.1 Station Environment and Principles

The case comparison of Xi’an and Brussels central station mapping shows that Brussels central station has a heather network environment condition.
- Higher density
- Fewer cul-de-sacs
- More connections in between two sides of railway
- No sense of segregation.

Source: Reconcile Railway with City, Ran Hu/ 2010 Master Thesis of TU Delft
TGV Station, Lille
By Rem Koolhaas

- Transition in vertical space and horizontal space
- Leave new with old
- Mixed Function of attraction: Traffic center/office center/shopping mall/service center/culture center/plaza and city park

- Human scale of old urban fabric, influenced by big project, becomes friendlier
- The point where old and new meet
- Transition area with abundant urban space (Street & square and building)

King’s Cross Rail Station, London
By Norman Forster

- Respecting of history
- Transition in principle
- Park surrounded by smaller blocks

Figure 3.2.2: Introduction of TGV Station Lille

Conclusion:

What is the role of a railway station?
- Gateway to the place
- The public facade of the city
- Open for everyone - a public building
- Transport logistics: bus, taxi, subways
- Accessibility to a wide range of urban functions

What are the important elements for a railway station?
- Ticket service
- Transfer system reasonable in space
- Waiting rooms
- Fast pass
- Hotel, shops and mixed functions
- Public spaces with place sense
- Landmark identity but friendly to environment
3.2.2 Break Rail Barrier

To break the rail barrier, especially in the station area, usually vertical positions of station tracks are the most important element needs to be decided at first. We can divide the vertical track position into underground, subsurface, ground level and elevated. The vertical position of station tracks not only affects the station itself, but also influences the environment around it.

1. Underground

![Image 1: Underground Station](source)

2. Subsurface

![Image 2: Subsurface Station](source)

3. Ground Level

![Image 3: Ground Level Station](source)

4. Elevated

![Image 4: Elevated Station](source)

Example of Underground: Rotterdam Blaak

Station Rotterdam Blaak is an underground station combines train and metro lines in the center of Rotterdam, at the end of the Binnenrotte the Blaak. With the following advantages.
- Close to city centre and market
- No disturb of noise
- All directions, integrates into city network
- Landmark

Example of Subsurface

Foster + Partners Unveil Plans for New Ourense AVE Station in Spain

In this plan, the tracks are on the underground level but not enclosed in a tube, so it is an example of subsurface somehow.
- Combine of function (train, bus, parking, landscape)
- Daylight plays important role
- Urban public space
- Pedestrian links across city and the tracks
Example of Ground Level
Project Organisation Station Area of Utrecht Centraal

- Bring back the historical canals
- Pedestrian scale to city center
- Good connection for different routes (bike & people)
- Feeling of station

Example of Elevated
Essen Hbf

The remodeled central Station of Essen Hbf is a good example, which moves the tracks on bridge, and gives spaces for people on the ground level.
- Big transfer node combined train, metro, bus and also-services and shops together.
- Renovated facades and the wide main passage
- Lifts on the five platforms to give barrier-free
- Multi-layer for different functions

Conclusion - Comparison

<table>
<thead>
<tr>
<th>Underground</th>
<th>Subsurface</th>
<th>Ground Level</th>
<th>Elevated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Remove the barrier in city</td>
<td>- Decrease the influence of barrier in station area</td>
<td>- Access to the city center side is good</td>
<td>- Platforms more accessible and facilitates movement between either sides of city</td>
</tr>
<tr>
<td>- Allow other traffic to cross</td>
<td>- Accessible and easy to transfer</td>
<td>- Strong identity of railway</td>
<td>- Station building under the tracks gives both entrances a similar spatial quality</td>
</tr>
<tr>
<td>- No voice and vibration</td>
<td>- Multi-layer public transport support</td>
<td>- City view while entering the city</td>
<td>- Give spaces on ground level for passing and bus</td>
</tr>
</tbody>
</table>

Weakness
- Complex and expensive in construction
- Hardly connected with street level
- Long distance for tracks going down without cover waste space
- Cross barrier by overcoming height difference twice, via subway or bridge
- Form a major visual barrier required
- Long distance of rail bridge under bridge in bad quality of space dark and wet

Opportunity
- Long term upgrade at once
- Easy to update in future
- Feeling of two sides in different characteristics
- Energy saving by naturally climb-slower and drop-faster

Conclusion - Decision

Which option shall I choose as the first decision of the station area that affects the forms and principle?

After the case study and comparison analysis, the answer is keeping the rail in the ground level. The reasons as following:
- Tracks underground is a good choice but also a great construction work that can influence the whole city with a result of removing the barrier at once. It is a great plan that will lead a reconsidering of the location of railway and stations. That is a topic related to the regional and metropolitan strategic plan I could not able to handle within this thesis. for a long term plan of hindred years, I recommand the underground position.
- Track elevated needs a long distance for the bridge, which would become another visual barrier. And the underbridge space for at least 60m*135m (the length calculated with grading of 6% and height of 8m) in both sides along the rail tracks without sunlight has no basic quality for a good public space that can match the demanding of place identity.
- Track subsurface compared with the ground level, they both remain the shape of original track barrier, need twice up-down process to cross the station and bridges to cross the rail. For the subsurface ditch, cross the rail by bridge is the only choice, tunnel would be too deep for people. On the other hand, as an option that needs to change structure of the station, it don’t have much potentials in such a flat terrain.

Keeping the rail track on ground level, we can also take the advantages of the other options from the case studies, to make a good multiple design work.
3.2.3 Fabric of City Village

After studying the principle to the railway and station, another important fabric in the backside area is the city village, which is in a poor condition but has the strong characteristics and a typical life style. The aim of case study here is to find out the role of city village and a better way to improve the quality, and decide to leave or remove it.

There are a lot of examples of city villages rebuilding project in Chinese cities, with demolishing and new buildings. While the regeneration practices are more valuable in this field, which regard the old urban fabric and memory in city village important and focus on achieving a better quality in these villages.

Characteristics of city village:
- Memory of city, self shaping
- Great connection inside, activities in lane
- Open space and private space combined with a neighborhood feeling
- Low rent, located in center, social service support
- Confliction caused by evacuation between inhabitant and government
- Leave it
- Give the space for self renew
- Policy protection

Conclusion

Most of the city villages have the capability to renew itself gradually. Different from other urban area, inhabitants in city village are landowners. The land in villages are divided into small pieces without yardwalls, mixed and changeable. The self-management, depending on the requirement and market by the village committee, is keeping on renewing the village and facilities in a slow but efficient and democratic way.

According to the study, the conclusion is: the life style of the city village needed to be keep and protected, give the chance for them to renew itself shows the respect for tradition and urban memory, which is also health for the city.
4.1 Principle settlement

The frame of the station area consists of 3 different kinds of typical urban fabric: the Heritage Park, the city village, and the historical inner city. Because of the triplex barrier in the middle, the 3 parts are totally separated and isolated.

‘What is the good principle for the environment of station area’ is the first question in order to settle the principle that can work well in pedestrian scale.

Legend
- Old & New
- Big & Small
- Barrier & Connection
- Function & Typology
3 options to organize the principle system

The new principle system

Depending on the characteristics of the three different frames and the demand of decreasing the influence of the triplex barrier, the decision of the principle system is made as figure 4.1.3.

- Cross the triplex barrier by a main axis
- Extend the frame of city village into north and south in different routes
- Divide the north frame into smaller piece to achieve the mixable and flexible function and better connection in walkable distance.

4.2 Frame for Design

After the study of principles, the figure 4.2.1 shows the new frame of the station area.
**TOD in double traffic nodes**

The new frame moves the eastern metro station for 400m to the location shown on figure 4.2.2, in order to make the mix-function area benefits from it. The two traffic nodes bring a new condition for the station area, which provides the chance of regeneration by TOD in a better way.

**Flexible Mix-function area, playing with size and typology.**

In order to achieve the TOD benefits, the flexible and mixed function area provides lots of possibilities of combination in size and typology in pedestrian scale.

The functions that need to be considered:
- Public open space
- Commerce and Culture
- Public service facilities
- Entertainment
- Dwellings for relocation household
- Typology and facades matches the environment

Images 4.2.1: References for size and typology
Source: Unfortunately lost
4.3 Visual Integration Evaluation

The following figures show the improvement of the walkable connectivity after the new frame.

Axial Line Length

Axial Connectivity

Point Connectivity

Visibility 1st Movement

Visibility 2nd Movement

Agent Counts
4.4 Strategic Plan

The figure 4.4.1 shows the strategic plan for the whole station backside area.

- Connection to the south, cross the railway
- Connection cross the heritage park by walking bridge
- New Traffic Centre area on backside of train station
- Network in Pedestrian scale
- Naturally transation in principle with a human scale
- Keep the memory of city, merged city village into new urban fabric
- Active surrounding by openess tetris plan
- Mixed function projects around traffic node and centre, new attraction

The figure 4.4.2 shows phasing plan step by step

1. Station Core
2. Metro and bus nodes
3. Connection cross heritage park
4. Mix- function area part A
5. Mix -function area part B
5.1 Design Principle

For the train station connection would be the first step for the strategic plan, it is the
core project that the design start with.

As the research result before, the basic position of the rail tracks is on ground level.
But the next question that comes out is 'how to cross the ground railtracks in walkable
method?' There are two options as the figure 5.1.1 shows.

The demands need to be considered in design:
- Keep the main station building
- Remain the private houses in village as many as possible
- Reasonable routes and cycle (waiting rooms, passage, metro, bus, taxi)
- Attractive and landmark identity
- Combination of space and function
- Characteristics in both sides
- Friendly environment with 'place sense'

Considering the demands above, option 1 is better for the site.
VISUAL INTEGRATION TEST

This test of visibility is mainly about the different options in numbers of connection, location of main axis, and width of axis. The aim is to find out the best location and width of the main connection across the station, and if it is necessary to build up all connections at one time.

A. 2 Lines connection
   Main connection not match from north to south

B. 6 Lines connection
   Main connection match from north to south

C. 2 Lines connection
   Main connection wider and match north to south

D. 6 Lines connection
   Main connection match from north to south as a plaza
A. 2 Lines connection
Main connection not match from north to south

B. 6 Lines connection
Main connection match from north to south

C. 2 Lines connection
Main connection wider and match north to south

D. 6 Lines connection
Main connection match from north to south as a plaza

POINT CONNECTIVITY

AGENT COUNTS
Integration Across Railway Complex City/ Li Lu/ June 2012

A. 2 Lines connection
Main connection not match from north to south

B. 6 Lines connection
Main connection match from north to south

C. 2 Lines connection
Main connection wider and match north to south

D. 6 Lines connection
Main connection match from north to south as a plaza

Conclusion:
A-B: Big improvement means location plays the most important role
B-C: The more connections achieves the better condition, but limited by reality, the number of connection is not the most important element.
B-D: Wider route would make the connection itself more convinent and trractive for people.

VISIBILITY 1st MOVEMENT

VISIBILITY 2nd MOVEMENT
5.2 Short-term Design Project

5.2.1 Concept

This part shows the shaping of concept in the core project of station, which is the most important start project in short-term for the strategic plan. The 3D drawings show how it build up step by step.

CURRENT SITUATION

STEP 1
- Clear the buildings close to rail
- Shape the new space for north entrance.

passengers
STEP 2
- Renew the old station building
- Construction combined with bicycle pass and parking
- Roof light for the buildings behind main facade

STEP 3
- Plaza in air above the construction for people
- Roof gardens
- Lifts

STEP 4
- Waiting rooms
- Mix function building (tickets/restaurant/shops/hotel)

STEP 5
- Bus station
- Metro station
5.2.2 Masterplan

The first map shows the plan and basic function of the project. The second map shows the flow of people and traffic cycles.
SECTION A

Current Situation

New Situation
SECTION B

Current Situation

New Situation
North Entrance Facade Design

Once the station connects the two sides of railway, the north side will no longer be the backside of station, but the other front side of the station and city. The environment of the north entrance would be one important element to form a new image of the city as a gateway, which would be influenced by the quality of the north square. The façade design of the north would be flexible and changeable; these two drawings give the examples of it. The main façade consisted of the vertical cover of platform, the staircase, the waiting room and the hotel building. The vertical cover of platform is made of glass and metal gridding in different heights, maybe with waterfalls inside to make a strong feeling of traffic node. The façade of hotel building is divided into two parts, one is colorful glass bring rhythm and verify elements, another one is light color stone with concave in shape of historical buildings on surface.
5.2.3 Quantity

In this design project, the most important function is the hub of the station itself, which is always related to quantity of passengers. The following figures show the expected quantity of the “NEW” Xi’an Central Station. The new station would be not only a station for the rail passengers, but also for people passing the railway or need to use other transport such as metro, bus and bicycle, which can be called as people passing by.

In order to achieve a pedestrian friendly environment in the connection and new center area, public transport methods would be more encouraged in this area.

**Proposed Consist of Passengers in Xi’an C-Station(2020)**

- **80682** Rail Passenger
- **36393** Passing by

**Consist of Transport Method**

- 64% **metro**
- 6% **bus**
- 6% **Taxi**
- 6% **Private Car**
- 20% **Bicycle**
- 2% **Walk**

The calculation figures show the approximate results of runs in expectation:

- Every 15min, a Metro
- Every 15min, 4 Buses
- Every 1min, 1 Taxi
- Every 3min, 2 Private car
- Every 1min, 7 Bicycle in use
- Every 1min, 7 people passing by
5.2.4 Two Front Sides, Build up Identity

After the project, the Xi’an central station would have no backside but two front sides, and the identity of both sides would be important to form the impression of the city. The birds eye view and perspective images show how the identity of gate in Xi’an would be build up for two front sides. And in order to give the place sense, some details can be helpful, the reference also shows the quality that is needed in the project.
Integration Across Railway Complex City

Inside the Waiting Room

South Entrance for Bicycle Route

The Platform

Bicycle Parking Layer
Roof garden suggestions for city village

Landscape public space for plaza in air

Fence protection of air plaza

Green lifts

Public stair case

Roof light for mix-function buildings

Public stair case

Images 5.2.1: References for design project
Source: Unfortunately lost
5.3 Long-Term Ambitions
5.3.1 Traffic System

In the long-term ambition, the traffic system plays an important role in connecting two sides of railway and shaping a better public and pedestrian environment. The traffic system basically has 3 layers, Motor layer, Cycling layer and Pedestrian layer, in which, the pedestrian layer has a better and more convenient route in area, whatever from the north to south, or walking inside the city village and new center area.
ROAD PROFILE

6 kinds of typical and important roads selected on the map show how these roads lead the route to the station and the south side of railway.

Road Type A
- Pedestrian Route leads to station
- No motor allowed, totally pedestrian friendly
- Sidewalk along the small shops
Road Type B
- 1 lane motor road
- Narrow and not busy roads inside village
- Bicycle mixed with car

Road Type C
- Narrow roads inside village
- Seldom car
Road Type D
- Flexible 1-2 lane roads through residential area
- Height changing in sidewalk

Road Type E
- Flexible 1-2 lane roads inside village
  Slow and friendly for green traffic
Road Type F
- 2-lane road through in between
- Different characteristics for two sides
- Height changing for different traffic
- Easy to cross, pedestrian friendly
The mixed-function area is closely related to the double traffic node development, the function and density plan is aiming to combine different functions of public spaces, public facilities, living, commerce and office under the new framework, and achieve a better consequence.
5.3.3 Phasing

The whole project of integrating the station north area cross the triplex barrier from the new center related to historical center consists of several key projects. Considering the requirements and investment, the projects need to be developed in a certain sequence. The station and metro line are the two most important projects that can break the barrier and bring people, which should be the start point. And then more and more demands and investment for development would be involved, after all the potential of other connection would be seen.

**PHASING**

*Shape the new center from nodes to whole backside area step by step*

**PERIOD AND AIMS**

**Starting period**
- Demolish of building, shape the new space
- 1st pedestrian connection above land, with sunlight
- Convenient for local people and tourists
- Heritage Park become lively
- Important public space in station area

**Attractor shaping**
- New public transport infrastructure bring people
- New activities provide by mix-function area
- Place sense of lively pedestrian public space
- Show the potential of connections and backside area
- More investments involved for next period

**Plenty of Investments**
- More connections build for people
- Barrier totally decreased in walkable distance
- Investments for more projects
- Varies of facilities, culture activities and commerce entertainments shapes
- A new center form

**Ending period**
- All lines connected
- No barriers in zone
- Backside area totally related to historical center with a new identity
The evaluation part aims to test if the plan is worthy of consideration in the integration across the barrier of railway, and if it creates benefits for the current backside area and the city region of Xi'an.

In the neighborhood scale and city scale, space syntax would help to test and give the result of connectivity and integration.

In the metropolitan and regional scale, the interface within region would be tested.
6.1 Evaluation on Neighborhood Scale

6.1.1 Visibility Analysis and Comparison

- North Side achieve better integration and lively
- Big square would gather more people
- More connections reduce the pressure of main roads
- Connection point of station would provide a place to stay

BEFORE

AFTER
6.1.2 Space Syntax Analysis and Comparison

BEFORE

AFTER
6.2 Evaluation on City Scale

6.2.1 Space Syntax Analysis and Comparison

Before Integration

Improved Integration

BEFORE

AFTER
6.2.2 The new structure within city

A  The transformation of backside area to inside front

B  The new relation and roles of the rail stations of Xi’an
### 6.3 Regional Achievements

- The new interface of metropolitan area
- Enhance the connection of core cities
- New form of four-city region within 6 hours
- Key point of metropolitan area in middle, stronger characteristics of Xi’an

### 6.4 Conclusion

The conclusions consist in an answer to the main research question.

**How to integrate the backside surrounding of Xi’an Central Station to the city as a whole and towards the historic urban center?**

Considering the complex situation of the Xi’an Central Station area, simple connection cross the railway is not enough. The answer is to create centrality from the north side and reach the variable framework for the area, by the method of TOD.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Spatial Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Transport System</td>
<td>Railway/ Metro/ Bus</td>
</tr>
<tr>
<td>Typical Characteristics</td>
<td>Heritage park/ City village</td>
</tr>
<tr>
<td>Street Network</td>
<td>Pedestrian Friendly/Green Transport</td>
</tr>
<tr>
<td>Public Space</td>
<td>Human Scale/ Active empty spaces</td>
</tr>
<tr>
<td>Connection Point</td>
<td>Redesign of Station/ Bridges for people</td>
</tr>
<tr>
<td>Program</td>
<td>Concentration around traffic node</td>
</tr>
<tr>
<td>Function</td>
<td>Mixed function area around traffic node</td>
</tr>
</tbody>
</table>

### 6.5 Discussion

There are several aspects in this thesis can be considered for other city or regions:

**A. The backside and Sub Center**

In most of cities, rail barrier is a problem especially to the old city center. The way we treat backside should not be just to cross and improve, but to make it another front side. A sub center close to main center would benefits the area much more than a silence backside.

**B. City Village**

For developing countries that experience fast urbanization, city villages or city slams seems disharmonious with the new urban fabric, but it is also a part of city history, and has a good inside structure. It is worth to be kept and improved.

**C. Method to cross railway**

Always for a long-term plan, new station should consider the underground rail track first. For those historical cities like Xi’an, change in rail lines would influence too much, the brilliant station design can provide a simple answer in a better consequence.

**D. Spatial Quality and Street Life**

To create a sub center for the station backside area is not only to consider about the function and density to make it lively, but the quality of the space inside and around the station is equally important. Street life and pedestrian friendly environment help to make the sub center area a place that people prefer to stay.
PART VII

Source of Information