# Strategic niche management of the internet bike rental in China

## A case study of Hangzhou

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**Graduation thesis**

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Cover image: "Tourists recently ride shared bikes in the Olympic Forest Park in Beijing", retrieved from: https://www.caixinglobal.com/2017-05-23/101093496.html.

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# Executive summary

With the population growth and the increasing demand, our current consumption model is not sustainable and could possibly lead to resources depletion and excessive pollution to the environment. Sharing economy offers an opportunity to address this problem, thus has drawn a lot of public attention in recent years. Thanks to the radical innovation of digital technology and information technology, the concept of sharing economy has also spread to the transportation sector. The recently emerged internet bike rental is one of the examples.

This research looks into this newly-emerged bike sharing system with the aim of identifying the development of the internet bike rental in China and exploring the potential solution that could alleviate the current issues that the internet bike rental encounters. Hangzhou was selected as the case to perform an in-depth analysis. The theoretical frameworks of Strategic Niche Management (SNM) and Multi-Level Perspective (MLP) are applied to analyze the breakthrough of the internet bike rental. On the basis of this framework, this research starts with the analysis of the external environment (landscape and regime) of the internet bike rental to identify the factors that could either stimulate or impede the development of the internet bike rental. Then, this research looks deep into the development of the internet bike rental in Hangzhou to analyze the internal processes and identify the issues it currently encounters.

The results show that the development of the internet bike rental in Hangzhou is still in the initial phase. Generally speaking, the external environment is considered to be favorable to the development of the internet bike rental. At the landscape level, a number of landscape factors are considered to be favorable to the development of the internet bike, such as the supportive national policy, the needs for new economic momentum and the growing environmental concerns. At the regime level, although the current Hangzhou mobility regime is locked by the steady user demand of private cars and well-developed automobile industry. The future Hangzhou mobility regime is considered to be positive for implementing the internet bike system due to the increasing traffic pressures, the surging growth of public transport and the well-planned urban slow traffic system.

The development of the internet bike rental in Hangzhou could be distinguished into three phases. In the first two phases, the internet bike companies and the users are the only stakeholders. However, when the internet bike began to cause a series of problems to the traffic system, more stakeholders began to be involved, including the media, researchers and Hangzhou government. The government's participation largely affected the direction of the development of the internet bike rental. They started to publish several guidelines to regulate the internet bike development. There are several issues related to its current development. Firstly, the current development of the internet bike rental still pretty much relies on the venture capitals from the investors. Secondly, although Hangzhou citizens have been involved in the internet bike niche, their opinions are not well articulated. Thirdly, most stakeholders still believe in that the internet bike has the potential to be largely implemented and bring positive social and environmental impact. However, this expectation is considered to be a little blindly optimistic. Fourthly, the

lessons on the environmental contribution of the internet bike rental are not convincing. Last but not the least, although there are fruitful lessons on the policy aspect, the companies' behaviors are still questionable since the published regulations don't have the legally binding force.

Based on these findings, several suggestions are given. Firstly, it is important for the government to identify the potential risks of the internet bike rental rather than blindly encouraging its development. More specifically, how many bikes are really needed in Hangzhou and in what way should the internet bike system being operated need to be clearly identified. Secondly, to facilitate the participation of Hangzhou citizens, it is recommended that the government could establish a specific platform to stimulate the citizens to share their opinions about the internet bike rental. Besides, it is suggested that the government and the companies could implement reward and penalty scheme to regulate the users' behavior. Thirdly, it is suggested that the research on the environmental contribution of the internet bike rental should be conducted by a third party and should reveal the real environmental impact of the internet bike rental on the basis of its current excessive production model. At last, it is recommended that more regulations with legally binding force are needed to ensure the cooperation from the companies side.

# Table of Content

# Chapter 1

# 1. Introduction

In the first chapter, the research context is explained in section 1.1. The problems and research aim are identified in section 1.2. The case city of this research is introduced in section 1.3. At last, the research questions are developed and the outline of this report is demonstrated in section 1.4.

## 1.1 Research Context

Bike-sharing is not a new word for most of us. A bike-sharing system can be seen as a Product Service System (PSS), which the service provider keeps the ownership of the bike and the customer only purchases the right of using the bike over a certain amount of time (Mont, 2002). By provisioning dematerialized services, Bike-sharing offers an opportunity to replace material intensive product consumption while reducing the associated environmental impacts (Mont, 2002). The benefits of implementing bike-sharing in the urban area mainly include two aspects. First, bike-sharing could reduce the environmental impacts of our intensive transport activities. For example, the bike sharing system launched in Lyon had saved the equivalent of 18,600,000 pounds of CO2 emission during its operation from 2005 to 2009 (Greater Lyon, 2009). Second, bike-sharing also has the potential to ease the increasing traffic pressures (Faghih-Imani et al., 2017). By offering the first/last mile connection to the major transits, It has shown that bike-sharing could contribute to decreasing the use of personal vehicle (Gaode Map, 2017).

Existing for nearly 50 years, bike-sharing has recently witnessed a widespread global growth. According to ITDP (2013), three generations of bike-sharing systems could be distinguished over the past 50 years. The first generation began in 1967 in Amsterdam, the Netherlands. Proposed by Councilman Luud Schimmelpennink, nearly 20,000 bikes were painted white and distributed all around the city center. The bikes were provided with no locks and were free of charge. This program didn't go as planned and collapsed within days. Most of the bikes were taken for private use, some of them were even thrown into the canals. To address these issues, in 1991, the second generation was introduced in Copenhagen, Denmark (ITDP, 2013). To keep the bike from being stolen, the bikes were chained to a bike parking racks with coin-operated locks. However, the second generation still suffered from vandalism and didn't perform well.

In the following years, bike-sharing developed slowly. But the situation was changed when Lyon’s Velo’v system was launched in 2005 which became the milestone of the third generation of the bike-sharing system (OBIS, 2009). This time, advanced technologies provided a solution to the previous safety issue and also assisted in rebalancing the bikes between different stations. To increase accountability, the users were required to provide the proof of identity when they

register for using the bike. Besides, most bike-sharing systems in Europe and America adopted credits system which users might be charged with a fine on their credit cards if they failed to return the bikes (ITDP, 2013). It was said by the year of 2009, there were 120 third generation programs that either had already existed or were under planning (Shahsavaripour, 2015). In 2013, the number of cities with the bike-sharing program had exceeded 700 (Fishman, 2015).

In China, the first bike-sharing program was launched in Beijing, which was operated by a private company (Zhang et al, 2014). The program ended in 2011 due to the bankruptcy of the company and didn't gain much public attention. It was not until the successful implementation of the public bike system in Hangzhou that the bike-sharing started to enjoy a surging growth around China. Until 2013, there had been nearly 120 bike sharing systems operated all over China. The number of the bikes had reached nearly 600 thousand (Figure 1.1)( Lohry and Yiu, 2015). All of these bike-sharing systems require fixed bike stations or docks, which users can rent and return the bikes at any of these stations. The systems were mostly set up and operated by state-owned enterprises. The local governments play an important role, which they provide the necessary financial support (subsidies) and the rights of operation (such as land use permit) (Pan et al, 2010, as cited in Lohry and Yiu, 2015).

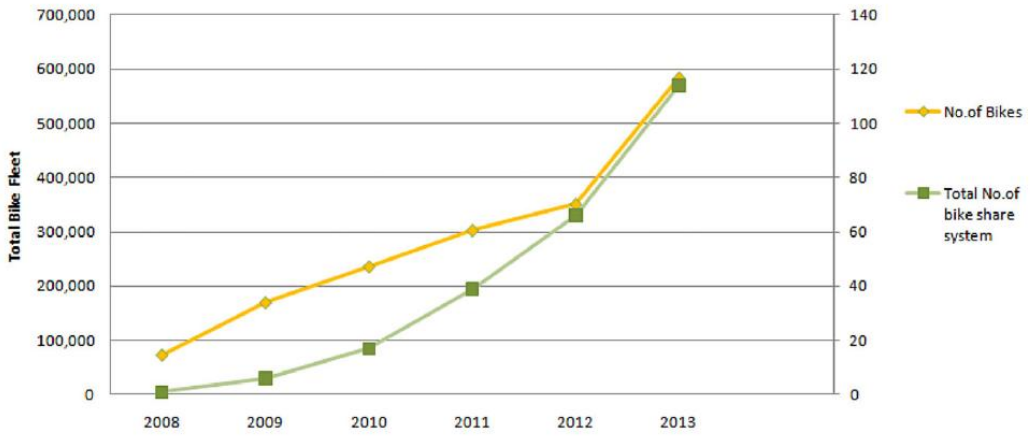


Figure 1.1. The growth of the bike sharing system in China (CESG, 2014, as cited in Lohry and Yiu, 2015).

Recently, a new bike sharing system called "internet bike rental" is emerging in the first and second-tier cities in China. Started from the end of 2016, the car-clogged streets of these cities were hit by fleets of colorful shared bikes. Different from the existing bike-sharing system, these bikes are not placed in the bike docking slots but are just lined up on the sidewalk. People scan the code to unlock a bike, ride and leave it virtually everywhere they want. The internet bike rental service is provided by different private companies with the purpose of making profits. The biggest innovation of this system lies in its adoption of the dockless design. By doing so, it avoids the construction of bike stations. People often find it more convenient since they only need to download an app that can offer them the location of the nearest bike, where they can unlock the bike by scanning the QR code on their smartphone. Just over a year, dozens of well-funded internet bike startups have emerged. Seemingly overnight, these internet bikes have become a new social trend and the key connecting tool in China's urban areas.

## 1.2 Problem definition and research aim

Over the past couple of decades, the rapid urbanization in China didn't give the government much time to cope with the traffic problems that emerged along with it. More and more trips in the urban area of the first and second-tier cities in China are taking place in the private cars which not only induces severe traffic congestions but also the environmental pollution. People and researchers have been calling attention to this problem and trying to seek for a solution. Among all the technological and social innovations proposed to alleviate this issue, the internet bike rental is a promising one. By advocating cycling in the city and collaborative consumption, the internet bike rental has the potential to increase the public transit use and cutting the emissions caused by the use of private cars. However, as a newly-emerged social innovation, it is far from stable to function as a well-integrated part of the urban public transport. Several researchers have argued that introduction of the new technologies is not an easy task, especially if they are related to sustainability and might lack superior economic performance or haven't been fully developed (van der Laak, Raven, and Verbong, 2007; Schot and Geels, 2008; Caniëls and Romijn, 2008).

The aim of this research includes two aspects. The first aspect is to provide a complete picture of the development of the internet bike rental since there is currently no research focusing on this newly-emerged bike sharing system. The current research on bike sharing in China was mainly focusing on the bike-sharing system with the fixed stations, which is operated by the government (Qian, 2011; Shi et al, 2011). Most of these research did a multi-cases comparison which didn't provide the in-depth information about each case (Lohry and Yiu, 2015; Zhang et al, 2015; Qian, 2011). The second aspect of the research aim is to provide the suggestions to the government for realizing the proper implementation of the internet bike system in the urban public transport system. The current internet bike system hasn't been fully developed yet. The dockless design, which is its biggest innovation, has also become its biggest potential risk. People park the bikes everywhere they want. Some bikes even appear in the middle of the street, which terribly affects the city's traffic system. Besides, the internet bike rental also hasn't found the right business model. Right now, these internet bike start-ups are still heavily relying on the venture capitals from the investors and haven't found a way of making profits. In this situation, what should the government do to guide the development of the internet bike system is worthy to explore.

## 1.3 Case selection

To investigate the development of the internet bike rental in China, a single case study is performed in this research due to the time constraints. As aforementioned, the internet bike rental initially emerged in 2016 in the first and second-tier cities around China (Beijing, Chengdu, Shanghai, Nanjing, Hangzhou, etc). Most of these cities are currently all facing the similar issues caused by the emergence of the internet bike rental and are at the same stage of the development of internet bike system. All of these cities are considered to have the potential to become the case in this research. In the end, Hangzhou is selected which is based on two reasons:

firstly, Hangzhou government is considered to have more experiences with regard to the management of the urban bike-sharing system. As aforementioned, the public bike system launched in Hangzhou in 2008 is a great success. It is reasonable to believe that Hangzhou government could have learned some experience that would be helpful for the implementation of the internet bike system. In that sense, the analysis of Hangzhou case could have the potential to generate more insights for providing recommendations to other cities in China. Secondly, the openness of Hangzhou government is another driver (for choosing Hangzhou). It is believed that this factor is helpful for collecting the data and ensuring the information richness of the case. For clarification, the public bike system refers to the bike sharing system with the fixed stations and operated by the government. The internet bike system refers to the bike sharing system with dockless design and operated by the private companies.

## 1.3.1 A brief introduction to the case area

Hangzhou, in short Hang, is the capital and the largest city of Zhejiang Province and is classified as one of the fifteen sub-provincial cities. Located in East China, Hangzhou is the deputy center city of the Yangtze River Delta and also one of the most important economic, cultural, financial center and transportation and communication hub of east China. Hangzhou is famous for its tourism. It has two scenic spots that are classified as the national park of China, namely the West Lake Scenic Area and the "Two Rivers and Two Lakes" Scenic Area attracting hundreds of tourists every year (Hangzhou China, 2017). The location of Hangzhou in China could be observed in Figure 1.2.

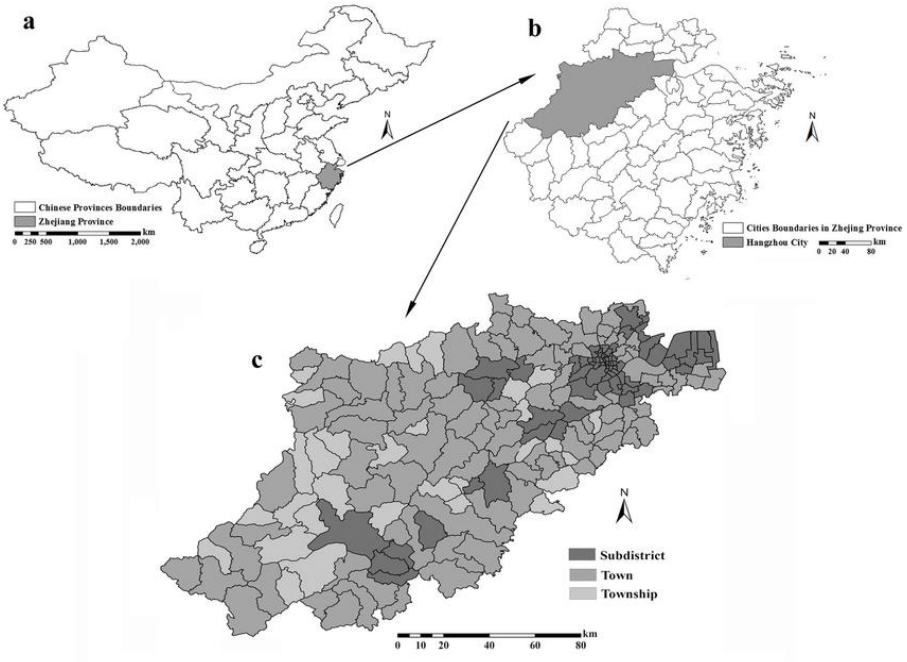


Figure 1.2. The location of Hangzhou in China and in Zhejiang Province (Fei et al., 2016)

At the end of 2015, The resident population in Hangzhou reached 9.018 million, of which 75.3% are urban residents. The natural growth rate of population is 4.21%. In the year of 2015, Hangzhou realized total GDP of 10053.58 trillion Yuan with the growth rate of 10.2%. It marks Hangzhou as the 10th city of which the total GDP exceeds more than 10000 trillion Yuan and ranked 4th among China's provincial capital cities. The GDP per capita reached 112268 Yuan with the growth rate of 9.1% and has reached the standard of the developed country. This high-speed economic growth continued in 2016, which the total GDP of Hangzhou reached 11700 trillion Yuan increasing 10% compared to the GDP of 2015 (Hangzhou China, 2017).

The jurisdiction of the City of Hangzhou includes 9 urban districts, two county-level cities, and two counties (see Figure 1.3). In this research, the geographic boundary is set as the urban area of Hangzhou including six central districts: Shangcheng, Xiacheng, Jianggan, Gongshu, Xihu, and Binjiang. These districts are the most populous areas in Hangzhou and are the places where the internet bike system is launched (Hangzhou China, 2017).


Figure 1.3. The administrative divisions of Hangzhou (En.gotohz.com, 2017)

# 1.4 Research questions and Thesis outline

## 1.4.1 Research questions

To conclude, this research looks into the development of this newly emerged internet bike system. The goal of this research is exploring the development of the internet bike rental and identifying the potential solution that could alleviate the current issues that it encounters. Due to the time restriction, one city (Hangzhou) is selected as the case to perform an in-depth analysis. In order

to guide the research, the main research question of this study is formulated as:

***In what way did the internet bike rental emerge and develop in Hangzhou and how could the issues it currently encounters being solved?***

To answer the main research question, the sub-questions are developed as:

1. What is the internet bike rental and how is it operated?
2. What theories could be used to address the main research question and how could they be applied in this study?
3. What are the external factors that have an influence on the development of the internet bike rental in Hangzhou?
4. Who are the stakeholders involved in the internet bike rental and how did these stakeholders foster the development of the internet bike rental?
5. What issues does the current internet bike rental encounter and how could these issues be solved?

## 1.4.2 Thesis outline

This report can be divided into seven chapters. The background information and research aim are introduced in Chapter 1. An introduction to the internet bike rental is given in Chapter 2, which could be used to answer the first sub-question: what is the internet bike rental and how is it operated?

The theoretical framework applied in this research is introduced in Chapter 3. The analytical framework and the data collection method are elaborated in Chapter 4. The outcomes from the Chapter 3 and 4 will provide the answers for the second sub-question: What theories could be used to address the main research question and how could they be applied in this study?

In Chapter 5, The external factors that can affect the development of the internet bike rental are identified, which are used to answer the third sub-question: What are the external factors that have an influence on the development of the internet bike rental in Hangzhou?

In Chapter 6, how the stakeholders contributed to the development of the internet bike rental in Hangzhou is identified. Besides, the issues and solutions related to the current development of the internet bike rental are also identified. The outcomes of chapter 6 could be used to answer two sub-questions: who are the stakeholders involved in the internet bike rental and how did these stakeholders foster the development of the internet bike rental? What issues does the current internet bike rental encounter and how could these issues be solved?

In Chapter 7, the conclusion is given, which answers all the research questions. The reflections and recommendations on broader relevance, the theories, and this research are also discussed.

# Chapter 2

# 2. What is the internet bike rental

The aim of this chapter is to give an overview of the technical features of the internet bike system and in-depth understanding of its business model and industrial model (supply chain). The results from this chapter can answer the sub-question: what is the internet bike rental and how is it operated? In this chapter, The worth mentioning technical characteristics of the internet bike system are explained in section 2.1. Its operating model is explained in section 2.2 which includes the overview of the internet bike companies, the industrial model and the business model of the internet bike rental. The conclusion is given in section 2.3.

## 2.1 Technology description

As aforementioned, the internet bike system differs from other bike sharing systems because it adopts the dockless design which allows the users to park the bikes everywhere they want. However, the internet bike itself doesn't differ much from the regular bike. There is hardly any advanced technology applied on the bike. For all the bikes currently operated on the market, they are all equipped with single gear and regular bike frame. What's new is the combination of regular bike and mobile internet technology. With the help of information technologies, users can see a map of all the bikes parked in the vicinity and unlock the bike by directly scanning the QR code using their smartphone (Chen, Z., 2017). In this section, the technical features of the internet bikes are introduced from two aspects: the technologies related to the bike lock and the technologies related to the bike parking.

### 2.1.1 Bike lock technologies

The main innovation of the internet bike design lies in its bike lock (see Figure 2.1). For now, according to E-Stronger (2017), although the configuration of the bike locks may vary from the bikes operated by different internet bike companies, most of the currently operated bikes are adopting the smart lock that could automatically open after successfully scanning the QR code. Some of the currently operated bikes are equipped with more advanced Bluetooth locks, which allows users to use the Bluetooth function to unlock the bike faster. The technical composition of the smart lock is complicated which will not be fully elaborated in this report. But generally speaking, The lock is normally equipped with a communication chip, a GPS chip, a battery, and a sim card. The process of unlocking an internet bike can be explained as: first, the user finds the location of the bike based on the information offered by the GPS chip. The user completes the interaction with the bike lock through the Cloud Server which they send a message to the Cloud

Server to unlock the bike. After using, the bike lock would also send a message to the Cloud Server to confirm the final location of the bike and stop charging the credits (E-Stronger, 2017).

Figure 2.1. Mobike's smart lock (E-stronger., 2017)

## 2.1.2 Parking technologies

The prevalence of the internet bike rental pretty much lies in its dockless design. The idea of picking up and dropping off everywhere brings a convenience that most people have never experienced before. However, this characteristic of the internet bike system has also caused the illegal parking issue which people park the bikes on the road or in the middle of the sidewalks. This phenomenon stimulated the development of another important technological innovation, which is the technologies related to the bike parking. Among all the parking technologies, the electric fence is the most distinguished one. The electric fence applied on the internet bike system is not the barriers that would release electric shock when someone or something crosses it. It can be understood as one designated virtual parking area. The intention is to regulate the user behaviors and guide them to park the bike in this designated area. If the user failed to park the bike in this area, the bike would not able to be locked (Sina.com, 2017). The electric fence normally adopts the GPS technology or Bluetooth technology. Some of the internet bike companies have already launched their own electric fence system, such as Mobike's "Smart Mobike Preferred Location" system (Sootoo, 2017).

## 2.2 The operating model of the internet bike system

### 2.2.1 An overview of the internet bike companies

Before introducing the industrial and business model of the internet bike system, an overview of the internet bike companies should be first provided. According to Chen, Z. (2017), the biggest internet bike startups in China are ofo and Mobike, which occupy the majority of the current market. ofo was initiated as an entrepreneurial project by four college students of Peking University and was only launched on the campus in the beginning. In the end of 2016, ofo decided to launch their bike system in the city. Mobike is another startup which was founded and owned by Beijing Mobike Technology Co., Ltd. Different from its rival ofo, Mobike started its operation directly in the city of Shanghai (Cha and Shu, 2016). The explosive growth of internet bike companies was at the end of 2016 and the beginning of 2017. A lot of bike sharing startups emerged during that time, including Coolqi, Haluo bike, Youan bike, etc. (Chen, Z., 2017).

After raising several rounds of funding from a group of investors, Mobike and ofo now have completed a combined 50 million rides per day (Lipton, 2017). They each acclaimed having 100 million registered users, providing their services in more than 100 cities around the world and operating a fleet of more than 12 million bikes (Lipton, 2017). Until the second quarter of 2017, the internet bike companies could be clearly distinguished into three groups, which ofo and Mobike formed the first-tier group among all these players (Figure 2.2) (iResearch, 2017).

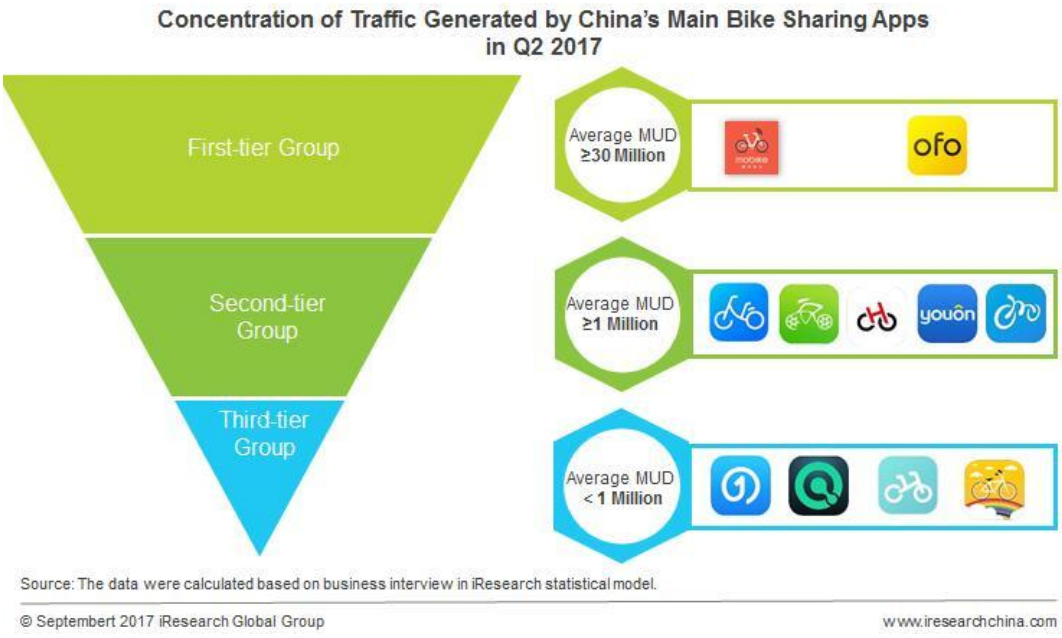


Figure 2.2. The concentration of Traffic generated by China's Main Bike Sharing Apps in Q2 2017 (iResearch, 2017).

## 2.2.2 The industrial and business model

The internet bike companies don't produce the bikes by themselves. They acquire the bikes from traditional bike manufacturers around China. The bikes are normally produced in a centralized way and are transported to the cities where the companies operate their systems. The internet bike companies are mainly in charge of the operation of the system and the maintenance of the bikes. To use the bike, the user needs to have a smartphone installed with the mobile payment app. The supply chain of the internet bike rental service is demonstrated in Figure 2.3.


Figure 2.3. The supply chain of the internet bike business (created by author)

The business model of the internet bike rental is classified as an $O_2O$ (online-to-offline) model. In short, this model entails the customers to purchase the product online and consume them in the real store (Xiao and Dong, 2015). In the case of internet bike rental, all the transactions are finished on the user's smartphone, which users pay the rent for the amount of time they use the bike. Before using the bikes, the deposit is needed to be paid.

The competition between different internet bike companies is intense. Most of the internet bike companies adopt low price strategy to attract more people to use their bikes. Currently, the internet bike companies haven't found a way of gaining profit and are mostly relying on the venture capitals to maintain their operation. The investors are committed a lot of capitals on this bike sharing scheme, which provided the necessary financial resources for the companies. According to Liu, j. (2017), within two years of time, Mobike had raised 5 funding rounds with the total amount of more than 10 billion dollars. Meanwhile, Its competitor ofo had raised 7 funding rounds and just accomplished a new 7 million dollars funding round led by Alibaba Group in July 2017, which broke the record to become the highest single funding round in the internet bike rental industry (Sina Tech, 2017). The huge investment is caused by the positive market potential of the internet bike rental. According to Wang (2017), in 2016, the users of the internet bike rental were 28 million. This number was expected to reach 209 million by the end of 2017 (Wang, 2017).

## 2.3 Conclusion

The internet bike rental is a new bike sharing system emerged in 2016. The smart lock is its most distinguished technological feature. Users could directly unlock the bike by scanning the QR code. Another innovation is its adoption of the dockless design. It allows the users to park the bikes everywhere they want without the need to find a bike station. However, this characteristic of the internet bike rental has caused several parking issues, such as people park the bikes on the road which terribly affect the traffic. To address these issues, the parking technologies are needed. The electric fence is the most commonly used parking technologies. It can be understood as one designated virtual parking area. With the help of information technology, if the user failed to park the bike in this area, the bike would not able to be locked.

A lot of internet bike companies have emerged within one year. Most of these internet bike companies don't produce the bikes. Instead, they acquire the bikes from the bike manufacturers. The bikes are normally produced in a centralized way and transported to different cities. The internet bike companies are mainly responsible for the operation of the system and the maintenance of the bike. Currently, these internet bike companies haven't found a way of gaining profit. All of them are relying on the venture capitals from the investors.

# Chapter 3

# 3. The theoretical framework

The aim of this chapter is to find out what theories could be applied to answer the research questions. In the literature research, it is found that two theories: Strategic niche management (SNM) and Multi-level perspective (MLP) could have the potential to offer a promising solution. In recent years, these two theories are frequently adopted by several social scientists in the Netherlands to demonstrate the breakthrough of innovations and to address the issues of introducing them to the society (Raven, 2005; Romijn, Raven and de Visser, 2010; Van Eijck and Romijn, 2008; Xue et al, 2016; Smith, 2006).

Raven (2005) adopted these two theories to demonstrate the development of the manure digestion and co-firing in the Netherlands and Denmark. Romijn, Raven and de Visser (2010) applied these two theories to explore the potential of implementing the improved cook stoves in India. The study found out that the affordability could be the most powerful trigger of the breakthrough of the improved cook stoves, alongside with other factors such as reduction of cooking time and better cooking environment (reduction of smoke emission). Xue et al. (2016) applied this two theories to evaluate the EV Demonstration Projects in China with the focus on the spatial difference of the niche development. The study found out that financial subsidies are the most effective protection measure on the national level. Besides, the study also identified the barriers that impede the wider diffusion of the electric vehicle, such as limited market potential, lack of new stakeholders, and poorly managed communication between manufacturers and customers. Van Eijck and Romijn (2008) used SNM and MLP to analyze the prospects for developing biofuels in Tanzania. The study provided useful insights on finding the barriers that the biofuels sector in Tanzania encountered, such as infrastructural and logistical problems, knowledge gaps, market price disadvantages etc. The results of the study also yield useful suggestions for the government to manage the development of the biofuels.

These two theories are elaborated and the theoretical framework of this research is developed in this chapter. The outcome of this chapter could be used to answer the first part of the sub-question 2: What theories could be used to address the research question? In this chapter, the theoretical background of SNM is introduced in section 3.1, while the theoretical background of MLP is introduced in section 3.2. The conclusion is drawn and the theoretical framework is developed in section 3.3.

## 3.1 Strategic niche management

The introduction of innovations to the existing system is difficult. From the social-technical perspective, an innovation doesn't only limit to the technical elements that are embedded in an

artifact, but also the social elements that include the regulations, actors and other social considerations (Kemp, Schot, and Hoogma, 1998). Kemp, Schot, and Hoogma (1998) indicated that there are several interrelated factors that could impede the introduction and the development of new sustainable innovations, which include: 1) ***Technological factors:*** the use of new innovations normally requires the presence of the complementary technologies that may not be currently available. Besides, the innovations might also haven't been sufficiently developed. 2) ***Policy factors:*** the unfavorable government policy may also become one barrier. Although the government itself might have the ambition to achieve some environmental protection goals, their policy normally fails to bring up a clear future plan for the development of sustainable technologies. 3) ***Cultural and psychological factors:*** the cultural meaning attached to the incumbent technologies (artifacts) might form the potential barrier to the new innovations. There is also a psychological reason that customers themselves may be skeptical about these new innovations and are afraid of using them. 4) ***Demand factors***: the factors in this aspect are often related to the economic aspect, such as new technologies may not meet the current demand of the customers and are expensive at the same time. 5) ***Production factors:*** these factors emerge from the supply side. The development of a technology from the laboratory to the real world can face a lot of uncertainties, such as the difficulties with building the relationships with necessary suppliers. 6) ***Infrastructure and maintenance factors:*** the implementation of new technologies needs the support from the infrastructure, such as the successful implementation of the hydrogen vehicle requires the widespread construction of hydrogen-equipped filling stations.

In order to facilitate the learning and enhance the future development and the application of new technologies, niches are created to protect these technologies against the harsh market environment and serve as the stepping stone for their wide diffusion (Raven et al, 2010). The concept of the niche was defined by Raven (2005, p.31) as the "locus for linkages between the variation and selection environment". It can either be special (normally isolated) geographical locations or particular application domains (Raven et al, 2010).

According to Raven (2005), there are four different types of niche depending on two factors (Figure 3.1): the protection and stabilization of the niche. The horizontal axis stands for the stability of the niche which is reflected in the niche development on several aspects such as the technological design, relevant regulation and user preference. The vertical axis stands for the level of protection which refers to how the niche is protected from the harsh environment in the regime. The protection methods include subsidies, tax exemption or other policy or financial support.

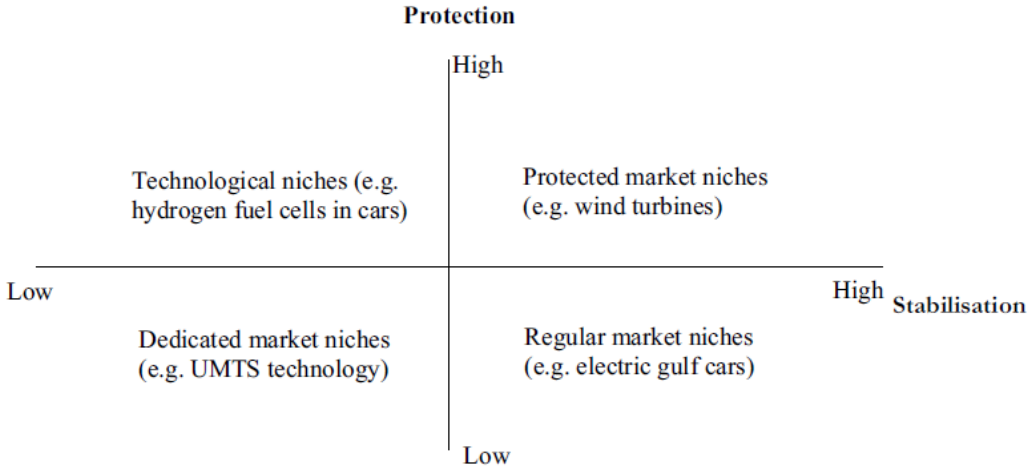


Figure 3.1. different types of niche according to the level of stabilization and protection (Raven, 2005)

The niche that has a high level of protection but low level of stabilization refers to the technological niche. It normally appears in the early phase of the niche development when the niche hasn't been accepted by the market but the niche developers or investors are supporting the niche with sufficient resources. On the contrary, the niche characterized by high stability and low level of protection is defined as regular market niche. Different from the technological niche, this kind of niche normally appears in the later phase when the technological characteristics of the innovation have been settled down and the niche has found a market so little protection is provided. The niche with high levels of protection and stabilization is named as protected market niche. It is when the technology and functionality have become stable but a high level of protection is still needed because the niche failed to make economic sense. Contrary to that, the niche with limited protection and stability is called dedicated market niche. In this kind of niche, the functionality of the innovation hasn't been settled. But some users might still have the interest despite the lack of stability (Raven, 2005).

Strategic niche management (SNM) is one recently developed analytical tool to facilitate niche development (such as from technological niches to market niches) through the experimentations with the co-evolution of technologies, market and institution (Schot and Geels, 2008). For the technological niches that have promising characteristics but lack stable market, SNM argues that "proto-markets" could be created to connect the market parties and the technologies, or in another word, link evolutionary variation and selection pressure (Caniëls and Romijn, 2006, p.246). Since different levels of selection pressures could trigger different evolutionary pathways, Schot and Geels (2008) argued that the exposure of the technologies to selection pressures should be well controlled.

The framework of SNM could contribute to understanding the difficulties that radical innovations would face when it is introduced to a higher level. It is a desirable framework to provide insights into the nature of the obstacles that innovations face and help to develop methods to overcome these obstacles (Caniëls and Romijn, 2008). Besides, the use of SNM can not only contribute to

building the understanding of the technological development but also can guide the technology in the desired directions. In brief, the management process complies with the following routine (Schot and Geels, 2008; Raven, 2005; Raven et al, 2010): firstly, an artificial niche is created to protect the technology innovation from harsh selections. Then, the involved actors could use this niche as the place to facilitate learning, constructing new networks and improving the innovation. So the innovation would gain momentum and replace the incumbent technology. SNM researchers described this final process as the transformation of the "socio-technical regime" (Geels and Schot, 2007). The concept of "socio-technical regime" will be further elaborated in the section 3.2.1.

SNM is normally used as a policy tool for the purpose of evaluating the existing policy and providing suggestions for the future policy making (Raven, 2005, as cited in Caniëls and Romijn, 2008). As aforementioned, the combination of these two theories has been applied to the analysis of various kinds of innovations including biogas, organic food, electric vehicle (Caniëls and Romijn, 2008). Most of the SNM studies are ex-post analyses and explanatory (Witkamp, Raven, and Royakkers, 2011). SNM researchers analyzed the success and the failure of the niche experiments through three internal niche processes (Raven, 2005; Schot and Geels, 2008). These processes will be further elaborated in the next section.

### 3.1.1 The internal niche processes

The evolution of the niche could be understood as the result of the interaction between three interrelated sub-processes: the voice and coupling of the expectations, network formation, and learning process (Raven, 2005). According to Caniëls and Romijn (2006), firstly, niches are formulated based on the stakeholders' expectations and the initial promise held out by the technologies. Then, guided by these expectations, niches are reconfigured through different forms of learning about technical possibility and constraints, the social acceptance, and relevant regulations. Simultaneously, the actors may change their perspectives about the technology and re-align their expectations over the time, while their views become more clear as the experiments revolve and their expectations can become more robust and specific (Caniëls and Romijn, 2006). The chance that a technological niche becomes a market niche and replace the current regime is higher when the aforementioned three processes are good and their interaction is well-managed (Witkamp, Raven, and Royakkers, 2011).

## Expectation

Normally, in the early stage of the technological development, the advantages of new technologies are not very clear yet, which cannot draw the attention from the public. Articulating expectations is important since they can attract attention, guide the design of the experiment in the desired direction, and encourage the actors to invest in the niche even if there are no short-term market benefits (Raven, 2006).

To implement the new technologies, the interested actors would make promises and try to raise the expectations. According to Raven (2005), these expectations are fragmentary and broad in the first place because different actors may have different perspectives and support different technological trajectories. The expectations are gradually shaped by the results of the experiments or by the participation of new actors. However, the most likely reason that causes the shift of expectations is the external force. The expectations would become more powerful if they are specific, shared among different stakeholders, and supported by the experiments and research (Raven, 2005). One way to enhance the expectation is to link the technology to the current social problems for which it could offer a solution (Schot and Geels, 2008).

## Network

The network can be seen as a social structure that consists of actors and their relationships. The formation of the network is important because it can provide the required resources for the development of the new technologies, such as expertise and financial resources (Schot and Geels, 2008). The network becomes more aligned if the interactions between the actors are well-managed. There are several ways to facilitate the interactions, in which meeting is the most common one. The regular meetings can provide a platform not only for sharing the perspective and knowledge but also for enhancing the cohesion and intimacy between different actors (Van der Laak et al, 2007).

According to Raven (2005), in the beginning, the network is small and quite limited. Only a few actors who have a vested interest are committed. The role of each actor is not yet very clear. Through the implementation of several experiments, the network might expand and gradually become stabilized. The resources within the network would increase and might facilitate the conduction of next experiments. Besides, when actors have gained enough experiences, their roles would become more clear. New actors might be involved and new network relationships could be formed, which contributes to building a more comprehensive and complete vision towards the future (Raven, 2005).

## Learning

Learning is an essential process in the niche management. A good learning process could increase the chance of successful diffusion of innovations by enabling the improvement of the technologies and its social embedding (Van der Laak et al, 2007). There are four different ways of learning, which are learning-by-searching, learning-by-doing, learning-by-using and learning-by-interacting respectively (Kamp, 2002). The goal of learning-by-searching is to understand "why". It's normally in the form of systematic knowledge search and self-study. Learning-by-doing is about knowing "how", which aims to gain tacit knowledge and the experience related to the niche management. Learning-by-using is intended to know "what". It

refers to learning by using the product which offers a way to learn the product characteristics from the users' perspective. At last, Learning-by-interacting is learning through the interactions with relevant actors in a physical or nonphysical meeting and conference (Table 3.1).

| Category of learning | Short term | Description |
|---|---|---|
| *Learning-by-searching* | *Know-why* | Systematic and organised search for new knowledge by R&D and study |
| *Learning-by-doing* | *Know-how* | Achieving knowledge to produce, includes tacit knowledge and counts for part of the learning curve in production |
| *Learning-by-using* | *Know-what* | Learning by users on how to use novelties |
| *Learning-by-interacting* | *Know-who* | Learning from users by producers through interaction |

Table 3.1. Learning in the innovation process (Kamp, 2002)

### 3.1.2 From Niche dynamic to regime transformation

The niche management could be seen as the interaction between these three internal processes (Figure 3.2). According to Raven (2005), at first, the design of the experiments is carried out by the incumbent actors with shared expectation. The outcome of the experiments is affected by the network characteristics and can serve as the basis of the learning process. The temporary results from the learning processes can reversely influence the expectation, which can either confirm the expectation or falsify it. The adjustment of the expectation might change the network composition, which new actors might replace the incumbent actors and conduct a new series of the experiments (Raven, 2005). Ideally, through this cyclical process, the technological niche could evolve into the market niche and finally change the regime. However, the involvement of the outsiders doesn't happen easily within the internal processes. External factors play a crucial role which could possibly become the drivers to stimulate these changes (Schot and Geels, 2008).

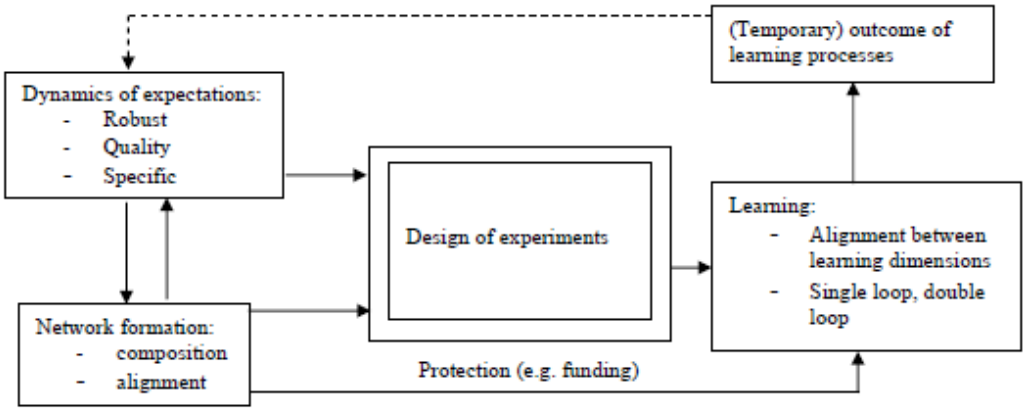


Figure 3.2. The dynamic of internal niche processes (Raven, 2005)

Geels and Raven (2006) stated that the recent studies of SNM have shifted the focuses from a single project to multiple projects. To understand the niche transition from the technological niche to market niche and to the final regime transformation, two levels can be distinguished, which are local project level and global level. As described by Geels and Raven (2006, as cited in Schot and Geels, 2008), the development of a niche can be understood as follows: in the beginning, the development of niche is mainly carried out by few local actors when the cognitive rules are not very specific. The local projects form the test beds for generating new ideas. The sequence of the local projects would become more aligned after these ideas are shared. Besides, the cognitive rules will become more articulated and stabilized. That's when the niche reaches the global level ( Figure 3.3).

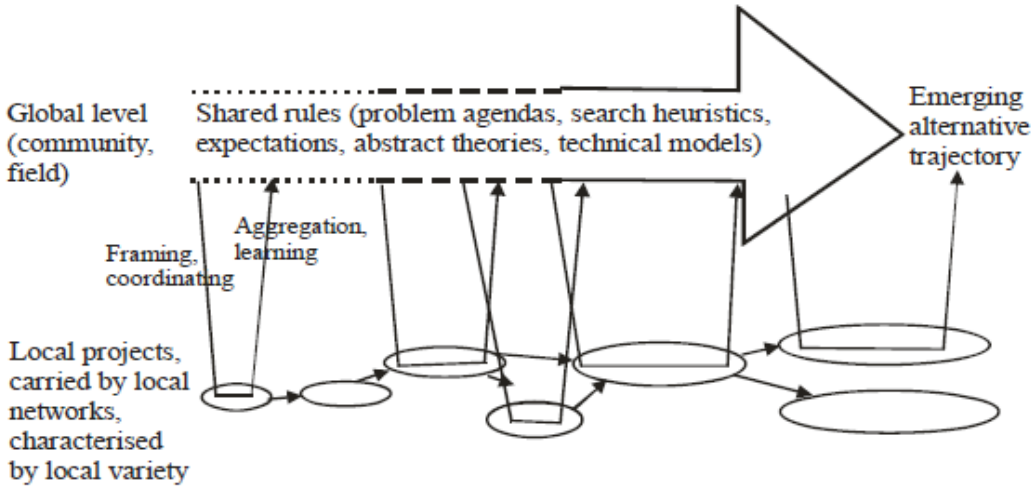


Figure 3.3. Emerging alternative trajectory carried by local projects (Geels and Raven, 2006)

According to Schot and Geels (2008), this conceptualization indicates that the process of an innovation replacing the dominant technology is not a success of one local niche but a sequence of all the local niches. In some occasions, the failure of one niche might contribute the success of the overall sequence (Schot and Geels, 2008). Thus, Geels and Deuten (2006, as cited in Schot

and Geels, 2008) emphasized that intermediary actors are needed at the global level to monitor the local project and circulate the knowledge transferring.

## 3.2 The Multi-Level Perspective

Researchers (Witkamp, Raven, and Royakkers, 2011) have argued that the analysis of niche development should not only focus on the three internal processes. In order to have a comprehensive understanding, It is necessary to investigate the interaction between the niche and its exogenous environment. To address this issue, SNM researchers advocate adopting the framework of Multi-Level Perspective (Witkamp, Raven, and Royakkers, 2011; Geels, 2002). They conceptualize three different levels along the trajectory of niche evolution, which include the niche, the socio-technical regime and socio-technical landscape. The theoretical background of MLP (Multi-Level Perspective) is elaborated in this section.

### 3.2.1 The Socio-technical Regime

Before introducing the concept of the socio-technical regime, the concept of the socio-technical system needs to be explained. According to Geels (2004), a socio-technical system consists of three basic elements: production of artifacts, distribution of the artifacts and the use of artifacts. As shown in Figure 3.4, the notion of the socio-technical system extends the analytic focus from the production side to both production and user side. The aforementioned three elements can be seen as three sub-functions, which additional resources are needed in order to fulfill these functions. For example, the production of artifacts need the resources such as natural resources, capitals, relevant knowledge and human recourses. Geels (2004) stated a complete socio-technical system of an artifact includes all three sub-functions and the associated resources which consist of knowledge, cultural meaning, labor, and regulation etc. The socio-technical system is the outcome of the activities carried out by human actors. But human actors are not autonomous, their actions are confined and coordinated by the institutions and rules that are interrelated. This "semi-coherent" set of rules forms the basic concept of the regime (Geels, 2004, p.904).

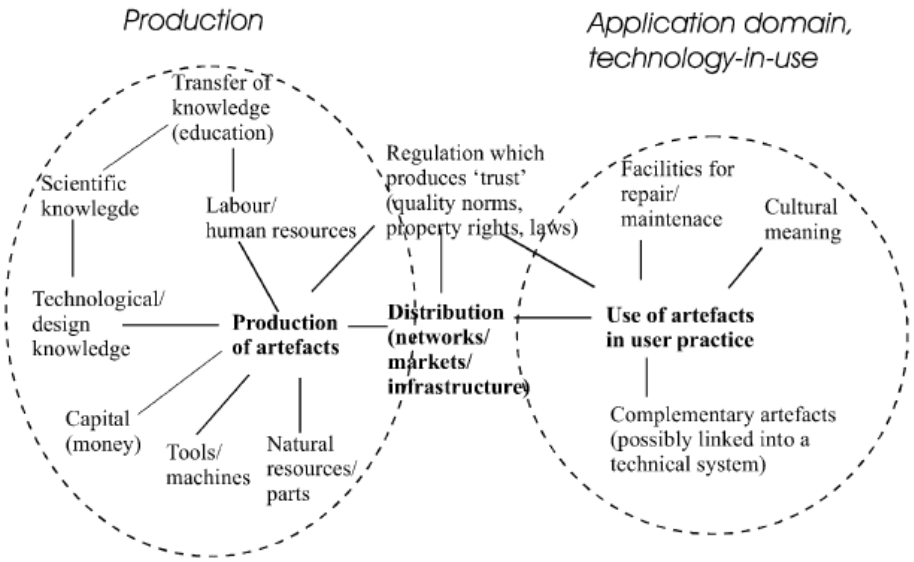


Figure 3.4. The composition of socio-technical systems (Geels, 2004)

Nelson and Winter (1982, as cited in Witkamp, Raven, and Royakkers, 2011) firstly proposed the concept of a technical regime. They stated the technological development follows a shared routine that will lead to an emerging pattern of technological change. Rip and Kemp (1998, p.338) later broadened this concept. They portray the regime as the underlying structure beneath the system of all the aspects that make up a technology (scientific knowledge, production procedure, product characteristics, and relevant infrastructures), which can be understood as a "grammar" that is embedded in the infrastructures and institutions. By incorporating the insights from sociology, Geels (2004) extended the concept of "technological regime" and proposed it as "socio-technical regime", which refers to the alignment of rules that help to build the linkages between different regimes (See Figure 3.5). The rules are upheld by these regimes and are centered around the technical artifacts (Raven, 2005). Different regimes are autonomous on the one hand but are also interdependent on the other hand (Geels, 2004).

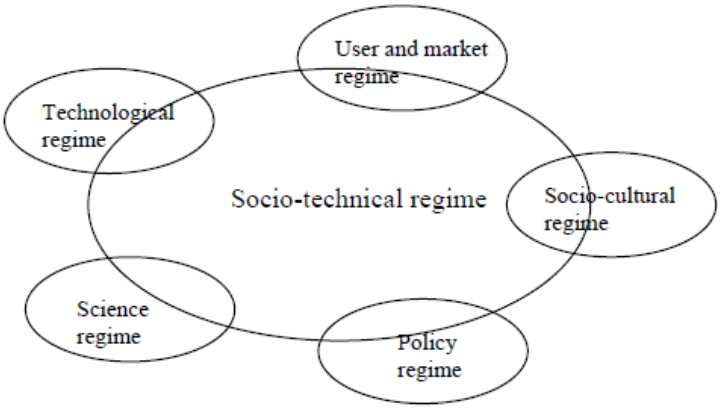


Figure 3.5. Meta-coordination through socio-technical regimes (Geel, 2004)

## 3.2.2 The Socio-technical Landscape

The socio-technical landscape embodies the external environment and sets up the structural context for regime and niches. It forms the background that sustains the society and provides necessary gradients for establishing a socio-technical configuration that serves structural, organizational, and functional societal needs (Smith et al, 2010; Kompella, 2017). There are several sets of factors that could be assigned to the landscape category. These factors constitute the external context that niche and regime couldn't influence in the short run (Geels, 2011). These factors include macroeconomic environment, political tendency, societal values, environmental and demographic change, scientific paradigms emergence, and cultural development (Smith et al, 2010).

Landscape changes can either support and strengthen the regime trajectories or exert stress that induces the instability of the regime and prompts the implementation of niche alternatives (Smith et al, 2010). However, the landscape changes could also exert influences that directly target at the niche in ways of affecting stakeholders' expectation and the size of the network (Geels, 2007).

## 3.2.3 The Multi-Level Perspective

According to Geels (2002), the success of new technologies is not only governed by the internal niche processes but also the alignment of the development of the landscape and existing regime. These three levels form a relationship that could be understood as a nested hierarchy (See Figure 3.6). The niche refers to the micro-level that accounts for the innovations generation and development; the socio-technical regime is the meso-level that constitutes the stable structure formed by the incumbent technologies; the socio-technical landscape is the macro level that includes slow changing contextual factors. A "nested hierarchy" relation means that niches are embedded within regimes and regimes within the landscape. So innovations generated in the niche are developed under the context of the existing regime and the landscape (Geels, 2002).

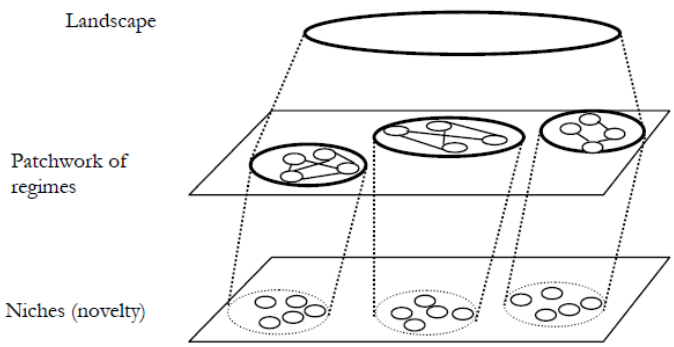


Figure 3.6. Multiple levels as a nested hierarchy (Geels, 2002)

The incumbent technologies in the existing regime have gone through a long process of evolution and adaptation and have become an integral part of the existing system. They are rather stable in the system and make it difficult for the radical innovations to replace them. Several researchers (Smith et al, 2010; Van der Laak, 2007; Smith, 2006) argued that regimes are usually locked in through various path dependencies including the incumbent practice, the cognitive framework, and other social, institutional, and technological factors. For example, the wide diffusion of wind energy might face the lack of supportive government regulations, insufficient development of basic infrastructure and the problem that the actors in the existing market have already formed interdependent relationships. These path dependencies are mutually reinforced and form the strong barriers to the introduction of the new technologies. It is only when the regime experiences a serious problem that the technical innovations could use this opportunity to break through the existing regime (Geels, 2002).

That is to say, the breakthrough of radical innovations normally starts from the mismatches that occur at the regime level. Normally, the trends and changes at the landscape level could create the *"window of opportunity"* that might exert pressure on the regime, which can induce internal restructuring (Geels, 2004). Two kinds of pressures can be distinguished. The first one directly targets at a specific regime. It could be cultural trends or the changes on social attitudes, such as the rise of environmental awareness; The second one is the social change which doesn't target to any specific regime (Smith et al, 2005). Such as the aging problem or the employment problem. Besides, the pressure can also be distinguished by its "intensity" and "speed", such as the regular change (gradual and low-intensity) and abrupt change (rapid and high-intensity) (Suarez and Oliva, 2005, cited in Geels, and Shot, 2007).

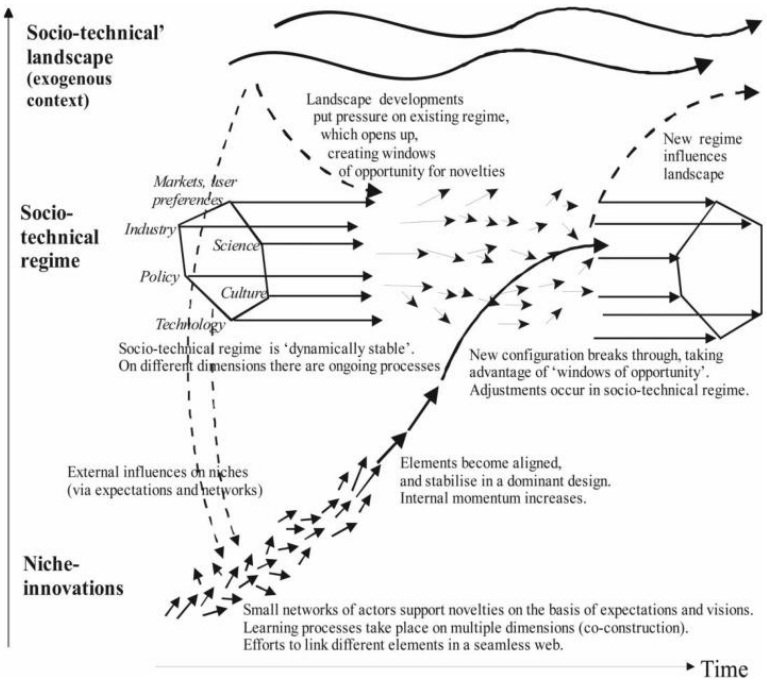


Figure 3.7. A dynamic multi-level perspective on system innovations (Geels, 2007)

Geels (2004) stated that there are also other reasons that could cause the mismatches and

tension on the regime, including internal technical problems, negative externalities on other systems, and the shift of user preference. The competence between companies can also open up the regime. Companies in the current regime may favor and invest one particular niche. Other companies would react to this move which will lead to strategic games between different companies. In this situation, the innovation might gain high momentum in a short amount of time which lead to abrupt system change (Geels, 2004).

At the regime level, six dimensions can be distinguished, including market and user preference, science, culture, technology, policy, and industry (Figure 3.7) (Geels, 2007). Each dimension is linked and interrelated with the other ones. The tensions and mismatches caused by aforementioned pressures would weaken the linkage between these dimensions and provide niche with the opportunity for breaking through. Normally on the niche level, there is no predominant direction of where the innovation is headed, which can lead to a variety of development trajectories. If the tension continues to exist, one radical innovation may use this opportunity to enter the market and to compete with the existing regime. Eventually, the old regime might be replaced and this newly formed regime can reversely affect the socio-technical landscape (Geels, 2002, 2004). In general, two mechanisms of the breakthrough of radical innovations can be identified. The first one emphasizes that the technical breakout is normally related to the strong growth in its associated market. The second one states that in the technological transition, new technologies can form a "symbiosis" relationships with the existed technologies, which they contribute to each other and solve bottlenecks that the regime currently encounters (Smith et al, 2005).

## 3.3 Conclusion

As aforementioned in section 3.1, the theory of SNM indicates that the evolution of the innovation could be understood as the result of the interaction between three interrelated sub-processes. It argues that the innovation would have bigger chance to break through the existing regime if the three internal processes are good and their interaction is well-managed. However, researchers have always criticized SNM for a bias towards niche-driven, bottom-up research model, which paid too much attention to the internal niche processes without identifying the influence from the external context (Geels and Schot, 2007). MLP could contribute to addressing this issue. By drawing the attention to the alignment of the niche development with broader developments (Geels, 2011), the theory of MLP argues that the breakthrough of innovations also depends on other external factors such as the stability of the regime and the trends at the landscape level. An unstable regime, which normally induced by the pressure from the landscape, could provide niches with more opportunities to breakthrough. To conclude from the literature research, It is evident that understanding the breakthrough of radical innovations needs the insights from both SNM and MLP frameworks.

Thus, in this study, a combination of the theoretical frameworks of Strategic Niche Management and the Multi-Level Perspective is applied to analyze the development of the internet bike rental in Hangzhou. This study applied this framework on analyzing the barriers and drivers at the

regime and the landscape level, demonstrating the past development of the internet bike rental, identifying its current problems, and exploring the possible solutions that could guide the internet bike rental towards a healthy and sustainable development. More specifically, the MLP was applied to analyzing the regime and landscape influence, while SNM was applied to identify the current issues that the internet bike rental niche encounters and was used to demonstrate the development of the internet bike rental in Hangzhou.

# Chapter 4

# 4. Methodology

The aim of this chapter is to identify in what way this research should be conducted. The results from this chapter could answer the second part of the sub-question: how could the theories be applied in this study? In this chapter, how the theoretical framework is applied in this research is identified in section 4.1. The method of data collection is introduced in section 4.2.

## 4.1 Analytical framework

As aforementioned in section 3.3, a combination of strategic niche management and the multi-level perspective is applied in this study. By combing these two theories, the development of the internet bike rental in Hangzhou could be derived. Besides, the issues that the internet bike rental currently encounters could be identified not only on the three internal niche processes but also on the regime and landscape levels. In this section, the analytical framework is developed to guide the analysis of the internet bike rental in Hangzhou. The stepwise processes of the analytical framework are illustrated in Figure 4.1.

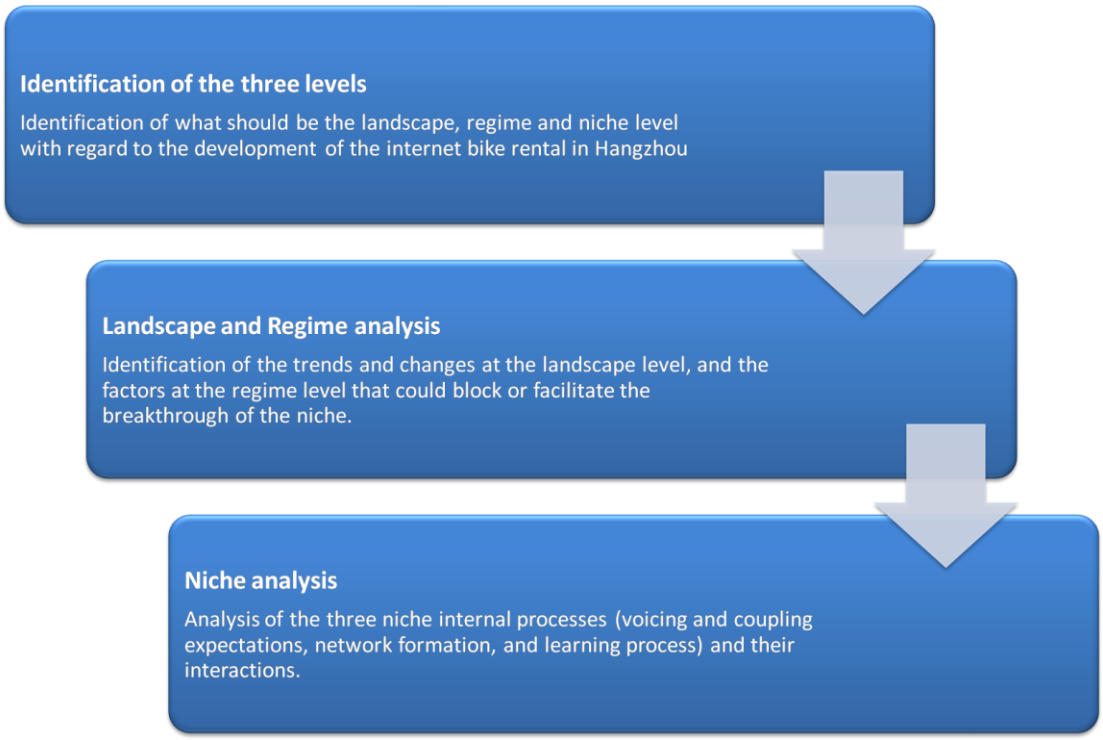


Figure 4.1. The analytical framework of this research

### 4.1.1 The identification of the three levels

The first step is to identify what should be the three levels of the internet bike rental in Hangzhou. Currently, there isn't any wide applied method that could contribute to identifying the three levels. Geels and Schot (2007) acknowledged that the empirical level of the object of research should be demarcated before operationalizing the three levels. In this study, the three levels were distinguished based on the research aim and scope. Because the case is selected as Hangzhou, the regime level is decided as the whole Hangzhou mobility regime. The niche is the internet bike rental in Hangzhou, while the landscape is the external environment over the Hangzhou mobility regime.

### 4.1.2 Landscape and regime analysis

This step identifies 1) the changes and trends at the landscape level that either stabilize or put pressure on the regime and niche, and 2) the stability of the regime and the factors at the regime level that could block or facilitate the breakthrough of the niche. The landscape and regime analysis should be performed before the niche analysis to first give an overview of the drivers and barriers in the exogenous environment.

#### Landscape analysis

Firstly, the changes and trends at the landscape level are identified. Geels (2011) argued that instead of making the landscape a "garbage can" that includes all kinds of external influences, the landscape concept could be more dynamic. The landscape could include three types of dynamics: the slowly-changing factors or the factors that are hardly changed, such as physical climate; the radical changes, such as financial crisis; and the long-term changes, such as global warming. The landscape analysis in this study paid equal attention to these three types of dynamics. Besides, the landscape factors mentioned in section 3.2.2 are applied to give an overview of the different aspects of the landscape, which include the macroeconomic and macro-political development, demographic changes, cultural evolution, and social values (Smith et al, 2010). On the basis of all these factors, the most relevant factors that affect Hangzhou mobility regime and internet bike rental niche are identified.

#### Regime analysis

Secondly, the analytical framework of regime analysis is developed. The insights from the eight components of land-based road transportation system proposed by Van Bree et al (2010) are derived for developing the indicators for the regime analysis. In the end, the regime was analyzed

based on three indicators: industrial development, market and user practices and the road infrastructure. The analysis of these three aspects didn't only focus on the tangible elements, but also on the relevant policy and intangible social norms and cultural values on each aspect.

- **Industrial development**: It includes the production system, industrial structure, and maintenance and distribution network that are embedded in the Hangzhou mobility system (Van Bree et al, 2010).
- **Market and user practices**: It includes the prevailing user (driver) preference in the current Hangzhou mobility system, which could be reflected by the market share of different transport modes and be interpreted by the underlying social and cultural norms.
- **Road infrastructure**: It includes the basic road infrastructure of Hangzhou mobility system, which mainly involves the status quo of Hangzhou urban road construction and future urban road planning.

### 4.1.3 Niche analysis

The niche analysis includes the analysis of the three niche internal processes: voicing and coupling expectations, network formation, and learning process. As aforementioned in chapter 3, most SNM research analyzes the success and failure of the niche experiments through the performance of these internal niche processes (Raven, 2005; Schot and Geels, 2008). Each of the three processes is an important characteristic of the overall niche development. The analysis of these processes could help to identify the problems of the niche development in a more comprehensive and structural way. In this study, the niche analysis is divided into two part: the historical development and the current development of the internet bike rental in Hangzhou.

#### Network formation

In this research, the network analysis is aimed at understanding the network composition in the different stages of the development of internet bike rental and identifying whether the interaction between stakeholders is aligned (the network alignment). To understand the composition of the network, a stakeholder analysis was performed to identify the involved stakeholders. The dynamic and the alignment of the network were identified and analyzed based on the qualitative data collected from the online resources and the interviews. Among all the different kinds of stakeholders, Raven (2005) argued that the user (consumer) is an important resource for innovation, who should be actively involved in the niche management process. Besides, Raven (2005) also argued the importance of the outsiders, such as non-users. Raven stated that the involvement of non-users are necessary since they might also be affected by the impact of innovation although they don't use it. Thus, in the network analysis, a special attention is given to the identification of whether the users and non-users (outsiders) are actively involved. The outcome of the network analysis could help to understand the development of the internet bike rental and provide the basis for the expectation and learning analysis.

- **Network Composition and dynamics:** first, a stakeholder analysis is conducted to identify the network composition. the analysis of the composition and the dynamics of network eventually focuses on 1) the stakeholder composition in the different stages of the development of the internet bike rental; 2) how these stakeholders related to the internet bike system; 3) how the network composition is changed through time.
- **Network alignment:** the strength of the network is analyzed by its alignment. Network alignment could be enhanced by the close connections between different stakeholders. It is evident that the well-managed interaction between stakeholders can strengthen the linkages and contribute to the stability and robustness of the network (Van der Laak et al, 2007). In this study, the alignment of the network is evaluated by identifying and evaluating the interactions between different stakeholders, such as whether the interactions between the stakeholders have stimulated engagement, trust and results on certain issues.

## Voicing and shaping of expectations

Hoogma et al (2002) stated that the voicing and shaping of expectations are good if the expectations are shared (robustness), credible (quality), and specific. The evaluation of these three different characteristics (robustness, specificity, and quality) could contribute to analyzing whether the expectation is powerful enough to guide the future niche development. But prior to the evaluation, the expectations held by different stakeholders should be firstly identified from different aspects. These aspects will be introduced in the "learning process" section. The identification of the expectations could help to identify whether the expectation in each aspect has promoted the corresponding learning process and generated any knowledge.

- **Robustness**: the robustness of expectation refers to the number of stakeholders that share the same expectation. The expectations are more robust if it is shared by more stakeholders. A more robust expectation could contribute to establish the mutual interest between stakeholders, enhance the commitment of the actors and the stability of the network. The robustness of expectation would increase if the expectation is shared by more and different kinds of stakeholders (Raven, 2005).
- **Specificity**: the specificity of the expectations could be evaluated by whether the actors in the network have a clear view of what next step should be taken to develop the technology to realize the expectation. A specific expectation is more trustful and could give a more clear guidance on the niche development (Raven, 2005).
- **Quality**: the quality of expectations is closely related to the robustness and specific side of the expectation. It could be evaluated from whether the expectation is supported by a number of experiments or research reports (Raven, 2005). The quality of expectation is good if the expectation is backed up by the trustful results from the long-term experiment (Van Eijck and Romijn, 2008).

## Learning process

A good learning process could increase the chance of successful diffusion of innovations. Learning processes can cover a lot of aspects. Hoogma et al (2002, as cited in Raven, 2005) developed five different learning aspects that can be used as the indicators to analyze the learning processes in the development of the internet bike rental, namely the technical development and infrastructure; the development of user context, social and environmental impact, the industrial development, and the regulations and policy. To have a comprehensive overview of the expectations and learning processes, all these five indicators were applied. These indicators are applied as the hints to remind the practitioner to collect the information about learning processes in different aspects. In this analysis, the knowledge generated during the niche management process was identified and collected, which are based on the literature research and the interviews. These results were then sorted out on the basis of these five aspects.

- **Technical development and infrastructure**: the learning on this aspect concerns about the technological feature of the innovation and its complementary infrastructure, which includes the learning about technological design, relevant complementary technologies, and basic infrastructure.
- **The development of user context**: the learning on this aspect focuses on the users' characteristics, including user composition, user demand and the difficulties related to the use of the technology.
- **Societal and environmental impact**: the learning on this aspect refers to the learning of social and environmental impact caused by the implementation of the technology. Such as its environmental performance, social acceptance, and social impact, etc.
- **Industrial development**: the learning on this aspect mainly involves learning the production and maintenance network of the technology. This includes learning the operation status in different industrial sectors (production, distribution, maintenance) and the business model if the technology has been implemented in the market.
- **Government policy and regulatory framework**: the learning on this aspect involves learning about relevant legislation, government's responsibility, institutional structures and the possible incentives.

At last, the development of the internet bike rental is demonstrated on the basis of the internal niche dynamics and the interaction between niche, regime, and landscape. The internal niche dynamics were analyzed from the interaction between the three processes. The framework proposed by Raven et al (2010) was selected to demonstrate the interaction within the internet bike niche, see Figure 3.2. Raven et al (2010) argued that the interaction of the three sub-processes follows a cyclic structure: the initial expectations held by the incumbent stakeholders would guide the learning process which might generate some temporary results. These results or the changes in the landscape and regime would induce the formulation of new expectations which might lead the adjustment of the stakeholder network. The incumbent stakeholders might leave and the new stakeholders might be involved which would carry out a

new series of learning. The analysis in this study used this structure to identify the development of the internet bike rental in Hangzhou.

## 4.2 Data collection

This section explains the method of data collection in this research. Firstly, the data was collected from the secondary data on the website, which includes peer-reviewed papers, industrial reports, news, and recorded press conference and TV programs. These data mainly serve as the sources for the analysis of the regime and the landscape changes. Besides, these sources also provided the majority of data for the niche analysis. "Wo men yuan zhuo hui" is a TV program which provided a lot of useful information and is frequently referenced in this study. It is a talk show where the leader of the government entities, researchers and the citizen representatives are invited to have a discussion about one topic. In this case, the topic is the development of the internet bike rental. Secondly, several semi-structured interviews were carried out to obtain the necessary data for the analysis of three internal niche processes. To ensure the interviews go smoothly, the following steps adjusted from Harrel and Bradley (2009) had gone through.

### 4.2.1 Frame the research

In the first step, the goal of conducting the interview was identified. In this research, there are two purposes to conduct the interview. First, the interviews are conducted to gather the perceptions, opinions, and attitudes from the different actors. Secondly, since the internet bike rental only emerged in last year, there are not sufficient secondary data that can be used in this research. The interviews are thus conducted to gather the necessary information that cannot be found in the existing literature.

### 4.2.2 Sampling

In the second step, the number and the types of the interviewees were determined. The target groups of the interviews were selected based on purposive sampling. During the preparation of the interviews, the types of the interview participants were initially determined based on the results from searching through the news reports and recorded TV program on the website. However, the number and types of the interviewees were adjusted according to the actual situation. For instance, some interviewees (such as investors) were neglected since they are difficult to contact. The intention is to select at least one interviewee from each stakeholder group including government entities, internet bike companies, the public bike company, and researchers. For the user interviews, a certain variety of the users was paid attention to include different types of users in this research.

A brief power-interest analysis was applied in this study to identify the target groups of the

interviews. According to Bryson (2004), The Power-Interest grid has two dimensions which arrange the stakeholder according to their interest in an identified issue and their power and ability to affect the future development of the issue. Based on these two dimensions, all the stakeholders could be distinguished into four categories: 1) The players: the stakeholders who have a strong interest and a great power; 2) The subjects: the stakeholders who have a strong interest but a limited power to exert influence; 3) The context setters: the stakeholders who have a significant power but not much interest; 4) The crowds: the stakeholders who have little interest and power (Bryson, 2004).

Before mapping out the power and the interest dependency of the stakeholders, each of the two dimensions should be briefly evaluated. Just to give an overview, the interest of the stakeholder could be evaluated by two indicators: the interests and the objectives. *The interests* refers to long-term interests which are relatively stable and abstract. *The objectives* refers to the short-term interests which are more specific. The power of the stakeholder could be evaluated by three indicators: important resource, replaceable and dependency. *The important resources* refers to the means for the stakeholders to exert influence. While *the replaceable* tries to find out whether the stakeholder could be replaced or not, *the dependency* tries to identify whether the resources are important or not (Bryson, 2004). The results of the power interest analysis could be found in Appendix A.

### 4.2.3 Developing the interview protocols

After the determination of the interviewee types, the next step is to design interview questions and interview protocols. Two types of the interviews were conducted in this research: 1) the expert interviews that focus on researchers, the public bike companies, and government entities; 2) the user interviews that focus on different types of users and non-users.

The interview questions were developed based on the aforementioned niche indicators. For different types of interviewees, the interview questions and protocol were developed separately (See Appendix B). However, the interview questions presented in the protocols only contain the general questions. The detailed questions were brought up during the conduction of the interviews depending on the role of the interviewee.

### 4.2.4 Interview conduction

The interviews were conducted in Hangzhou during October 11 to November 10 for one month. Eventually, 7 expert interviews and 24 users interviews were conducted. The expert interviews include four interviews with Hangzhou government entities (one with *Hangzhou Transportation Bureau*, two with *Hangzhou Municipal Administrative and Law Enforcement Bureau*, and one with the *Traffic police detachment of Hangzhou Public Security Bureau*), one interview with the public bike company (Hangzhou Public Transport Bicycle Services and Development Co., Ltd) and two interviews with the researchers (one with the researcher A from Zhejiang University of

Technology, the other with researcher B from the Chinese People's Political Consultative Conference Hangzhou committee. However, some Internet bike companies refused the interview request stating they would not accept any kinds of the interviews. Fortunately, some information is collected through participating one meeting that one internet bike company had with *Gudang detachment of Hangzhou Municipal Administrative and Law Enforcement Bureau* and through the inquiry with several staffs from the internet bike company. At last, the user interviews are conducted with different kind of users. The participants include 11 college students, 10 working class people, 3 tourists (See Table 4.1).

| Interviewee Type | | Number of interviews | Time |
|---|---|---|---|
| Hangzhou Transportation Bureau (Government entity A) | | 1 | On Oct 20th |
| Hangzhou Municipal Administrative and Law Enforcement Bureau (Government entity B) | | 2 | On Oct 18th and Oct 19th |
| Traffic police detachment of Hangzhou Public Security Bureau (Government entity C) | | 1 | On Oct 19th |
| Public bike company | | 1 | On Oct 25th |
| Internet bike company | | 1 | On Oct 19th |
| Researchers | Researcher A | 1 | Both on Oct 27th |
| | Researcher B | 1 | |
| Users | Student (Type A) | 11 | From Oct 16th to Nov 9th |
| | The Working Class (Type B) | 10 | |
| | Tourist (Type C) | 3 | |

Table 4.1. An overview of the type and number of the interviews

In this research, the expert interviews were mostly recorded by hand, while the user interviews were mainly recorded by recorder pen. The interview results were recorded in Chinese and later translated into English. For the user interviews, the results are sorted and distinguished into four different categories depending on the user type, which includes students, the working class, tourists and non-users. The interview information referenced in this report are illustrated in Appendix C.

## Chapter 5

# 5. The MLP Analysis

The three levels of internet bike development have been distinguished in section 4.1.1. While the landscape mostly includes the trends and changes at the city (Hangzhou) and the national level, the regime refers to the Hangzhou mobility and the niche is the internet bike rental in Hangzhou. In this chapter, the landscape and the regime are firstly analyzed based on the pre-defined indicators. The landscape analysis is conducted in section 5.1 while the regime analysis is conducted in section 5.2. The conclusion is drawn in section 5.3. The outcomes from this chapter could answer the sub-question: What are the external factors that have an influence on the development of the internet bike rental in Hangzhou?

## 5.1 Landscape analysis

The internet bike rental emerged in 2016 as a national phenomenon. There are several Landscape characteristics that have facilitated the introduction of internet bike. But there are also some characteristics that stabilize the current regime and might form a potential barrier to the internet bike rental. In this section, the trends and changes at the landscape level are identified from the perspectives of the macroeconomic development, the macro-political development, the environmental conditions, and the societal and cultural changes.

### 5.1.1 Macroeconomic development

On the national level, China has enjoyed a rapid economic growth since the implementation of the economic reform (the "reform and opening-up" policy) in 1979. From 1979 to 2004, the average annual gross domestic product (GDP) growth rate reached the astonishing 9.6% (National Bureau of Statistics of China, 2017).

However, in recent years, the high GDP growth rate has shown signs of slowing down. In 2016, China's GDP growth rate was 6.7 %, which is the slowest in 26 years (National Bureau of Statistics of China, 2017). Due to the trade protectionism and " manufacturing return" trend in the developed countries, the heavy dependence of China's economy on the investment and exports began to become a problem. Restructuring the economy to generate new internal momentum becomes more and more urgent (Economic daily, 2017).

## 5.1.2 Macro-political development

Several guiding opinions have been published at the national level that is relevant to the internet bike development. These guidelines reflected the national government's attitudes on several aspects but are all considered to be favorable to the internet bike development (iReaserch, 2017).

Firstly, the national government has the intention to stimulate the development of urban public transport system. The State Council of China published the "Guiding Opinions of the State Council on the Priority Development of Urban Public Transportation" in 2012 ( The General Office of the State Council, 2013). Stated in the Guiding Opinions, the national government is concerned about the urban transport development can't keep up with the development of urbanization. The government considers the urban public transport has the advantages of energy-saving, environmentally-friendly, and the ability to alleviating the traffic congestion, which should be advocated and developed in priority (The General Office of the State Council, 2013).

Secondly, the national government also encourages the development of the private economy. In 2013, China removed the minimum capital requirements (30,000 Yuan) for registering a limited liability company (Wei and Yu, 2013). This measure combined with other reforms lower the threshold for business startups. In 2015, The State Council of China issued the "Guiding Opinions on Expanding Makerspace and Promoting Innovation and Business Startups by the General Public" with the aim to promote business startups and create job opportunities by providing support to startup companies in eight aspects including improving public service, providing financial support and refining financing mechanisms, etc (Gov.cn, 2015).

## 5.1.3 Environment conditions

The current environmental issue in China has drawn a lot of public attention. Serious air pollution is on the top of those issues. The current smog problem not only induces the visibility or traffic issues but most important of all, endangers the health of every people who live in the cities. For different cities, the main contributor to the smog problems differs. According to results from the source apportionment of the smog in nine Chinese cities, The main contributor of the smog in Beijing, Hangzhou, Guangzhou, and Shenzhen is the exhaust from the motor vehicle; in Shijiazhuang and Nanjing is burning coal; and in Tianjin, Shanghai and Ningbo are flying dust, mobility and industrial production (Beijing morning post, 2015). But no matter in which cities, the exhaust produced by the motor vehicle is always one of the main contributors to the air pollution.

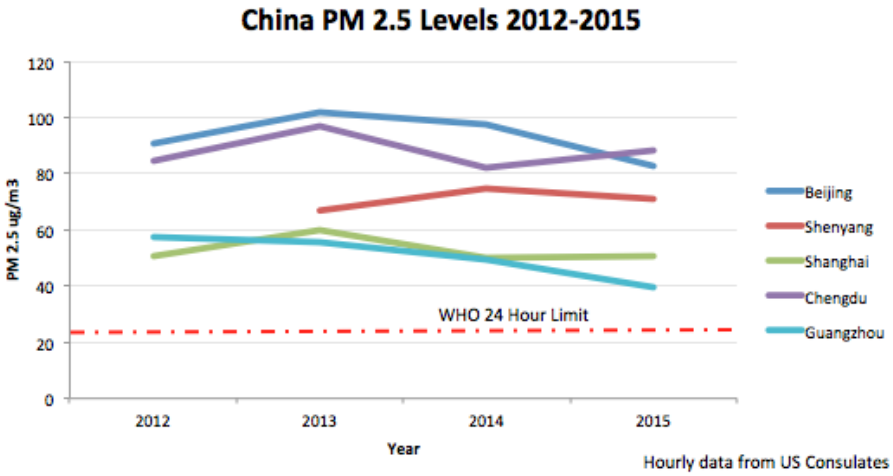


Figure 5.1 China Pm 2.5 Levels 2012-2015 (Quora.com, 2017)

According to the government statistics, the situation is getting better, which partially thanks to the tough action on the removing and reallocation of the heavily polluting factories and the construction sites (Fullerton, 2017). As for Hangzhou, The average density of PM2.5 of Hangzhou was 49 micrograms per cubic meter in 2016, which witnessed a 14% reduction on the PM2.5 figures in 2015 (Sun, 2017). However, the overall air qualities of the cities of China still need a big improvement to meet the worldwide standard (as shown in Figure 5.1 ).

## 5.1.4 Societal and cultural changes

One of the most distinguished societal and cultural factors that stimulate the internet bike development is the increase of mobile payment use. Mobile payment refers to the payment processes performed by mobile devices. The surging growth of mobile payment comes off a solid base of smartphone users. According to the statistics from Flurry, China was the world fastest growing smart device market in 2011 and had overtaken the US to become the biggest smartphone market in 2012 (Holt, 2017). It is said that the smartphone penetration rate in China ( the ratio of the total number of sold smartphones to overall mobile phone users) had reached around 40% in 2016 and still keeps a steady growth rate (Holt, 2017).

More and more people in China are adopting this cashless payment method. "The 39th Statistical Report on the Internet Development in China", which was released by China Internet Network Information Center, showed that China's mobile payment users have reached 469 million in December 2016 with an annual growth rate of 31.2% (Li, M., 2017). The emergence of the mobile payment has substantially changed the payment behavior of Chinese people and stimulated the development of a series of internet industries. Especially, Hangzhou has one of the best developed mobile payment environment in China, which is mainly because Hangzhou is where the e-commercial giant Alibaba located. It is said Hangzhou is the first city in China to realize mobile payment in its metro and public bus system (Xinhua, 2017).

## 5.2 Regime analysis

The current social-technical regime that the internet bike niche embedded mainly involves the Hangzhou mobility regime. The current Hangzhou transport system consists of two main modes of transport. Except for the private cars, there is also public transport which includes metro and bus. Overall speaking, the current Hangzhou mobility regime is still dominated by the automobile but is witnessing a trend of increasing share of public transport. The main focus of this section is to analyze the regime stability from aforementioned three aspects: market and user practice, the industrial development and the road infrastructure.

### 5.2.1 Market and user practices

The private car market in Hangzhou is huge. In 2007, the number of registered private cars had exceeded 1.32 million, in which 402.7 thousand were registered under the urban area of Hangzhou (Sun, 2015). In March 2013, the number of private cars in Hangzhou urban area had exceeded 1 million and the average private car ownership per three people is one (Zj.sina., 2015). Since then, Hangzhou had replaced Beijing and became the city in China with the highest private car ownership per capita (Zj.sina., 2015). These statistics show that the citizens in Hangzhou still prefer private cars as their main travel method. Hangzhou is a metropolis with a large urban area. In Hangzhou, a large number of enterprises are located in Binjiang district, which has relatively a long distance from the central urban area, such as Shangcheng and Xiacheng districts (see Figure 1.3). Due to this, the benefits of cars such as high speed, convenience are considered more attractive to the white-collar workers (Geels, 2012). Besides, there are also several societal and cultural factors that help to stabilize the current automobile regime. Due to the steady economic growth, private cars have replaced bikes and becomes the new symbol of wealth and social status. In the cities like Hangzhou, the car is one of those "must haves" and has become a necessity for marriage. Besides, It is believed that the current dominant user preference is still inclined to private ownership rather than collective use (Geels, 2012).

Compared to the dominance of the private cars in Hangzhou transport market, the percentage of people taking public transit in Hangzhou is only around 20% in 2013 (Chinanews.com, 2013). The current insufficient development of Hangzhou public transport system is the main reason. Firstly, the metro system of Hangzhou is still under construction. Hangzhou is currently only operating three metro lines (Hangzhou Metro, 2017). These three metro lines are mainly operated in the central districts (Xiacheng district and Shangcheng district) (see Figure 1.3). The coverage of metro system in the rest districts in Hangzhou hasn't been fully realized. Secondly, Hangzhou citizens are also not satisfied with the current Hangzhou public transport system. According to Chen and Yu (2016), the citizens believe the interval between bus runs was too long in the rush hour, which can't keep up with high passenger flows. Besides, the study also found that the speed of the bus is not fast enough due to the bus lanes were sometimes occupied by other vehicles.

However, there are still some positive factors for the public transport development in this aspect.

Due to the unoptimistic traffic conditions, the government of Hangzhou has implemented the traffic restriction that aims at relieving the traffic pressure in the rush hours. This measure to some extent has forced private cars users to choose the public transport. According to Bendibao (2017), the traffic restrictions come into effect during 7:00-9:00 and 16:30-18:30 on every workday in the central area of Hangzhou city, which is based on the last digit of license plate numbers. For example, on every Monday, the cars with the last digit of one and nine are forbidden to enter the central urban area during the aforementioned time.

## 5.2.2 The Industrial development

The development of automobile industry is highly driven by the market demand. As aforementioned, Hangzhou's economy is doing well. The steady growth of households income enhances the residents' consumption capacity, which stimulated the development of automobile industry and attracted many national and international automobile manufacturers to set foot in Hangzhou. According to Geels (2012), the automobile regime could be locked through a strong network of the different industrial actors. In Hangzhou case, although the production of cars does not necessarily happen in Hangzhou, It is reasonable to state that these automobile manufacturers have formed a close cooperation with their suppliers and thus ensure a steady supply of various kinds of cars.

Most of these automobile manufacturers have opened their retail shops in Hangzhou. These shops, normally called 4S shop in China (Sale, Spare part, Service, and Survey), provide the services including vehicle sales, spare part supply, after-sales service (maintenance), and feedback collection (Autohome.com.cn, 2014). The automobile manufacturers also collaborate with local insurance companies and local banks to provide customers with the options of different auto insurances and paying in installment. Apart from the aforementioned 4S shop, various kinds of third party repair shops also provide a wide range of decoration and maintenance service for all kinds of cars. It is believed that the strong network formed by these industry actors significantly ensures the stability of Hangzhou automobile regime.

Compared to the well-developed automobile industry, the public transport industry is still at an early stage but are enjoying a surging growth. Hangzhou government provides solid financial and policy support to the construction of the public transport system. As aforementioned, Hangzhou metro system currently only consists of three metro lines. Although most of the metro construction is still underway, It is expected that Hangzhou would establish a more comprehensive metro system within five years from now on (Hangzhou.gov.cn, 2017). The government plans to realize the construction of 10 lines in the city of Hangzhou before the year of 2022. At that moment, the metro system would sufficiently connect the city center with Gongshu, Xihu, Binjiang and Xiaoshan district. Besides, a steady growth could also be expected from the bus system, especially for the development of Bus Rapid Transit. The first Bus Rapid Transit Line (Line B1) started operation from April 26, 2006. After that, there have been B2, B3, and B4 in total four lines until 2011 that operated 160 vehicles and owned 126 stations with the operating distance of 81.4 Km. It is expected that 10 BRT lines would be established with the

overall operating distance of 218 kilometers by the year of 2020 (Hangzhou Public Transport Service, 2017).

Besides, the general policy environment in Hangzhou is considered to be favorable to the construction of public transport. According to Chen (2015), Hangzhou government now has set up its strategic goal of developing public transport system as "Five in One", which the "Five" includes urban rail transit(metro), public bus, taxi, public bike and water bus. This strategy identifies the overall approach of constructing public transport as metro and bus serving as the backbone while other three modes serving as the add-ons. It indicates that the priority of public transport construction is given to the public transport with high carrying capacities, such as metro and bus.

### 5.2.3 Road Infrastructure

The urban road infrastructure of Hangzhou has been developed in a manner to adapt more and more private cars. However, according to Sun (2015), there is a tension between the increasing number of private cars and the limited road resources. The difficulties in driving and parking in the urban area in Hangzhou have become more and more serious. The construction of the basic road infrastructure had gradually shown the inability to catch up with the substantial increase of the private cars (Sun, 2015). Similar to other major cities in China, Hangzhou also suffered from serious traffic congestion, which has become a normal phenomenon and has shown the trend to develop from the city center to the suburb area (Guo et al, 2011). According to the statistics from Gaode map (2016), among the 60 major cities in China, Hangzhou ranked as the 8th congested city in China (Guangzhou as No.10, Shanghai as No.11). The traffic congestion surely becomes a potential threat to the stability of the automobile regime in Hangzhou.

Overall speaking, the current condition of road infrastructure in Hangzhou is favorable to the cycling. Compared to other cities in China, Hangzhou has the relatively well-planned urban road infrastructure that provides clearly dedicated and separated bike lanes on the major road. In a survey conducted by Tan et al (2015) to investigate the condition of the bike lanes in 12 cities in China, Hangzhou has the above average bike-lane-equipped ratio and also good performance on the bike lane condition and maintenance. The survey, which was conducted in 2015, compared the bike lanes construction in 12 cities. In the 368 roads that investigated in Hangzhou, there were 139 roads that were equipped with bike lanes, which indicates the bike-lane-equipped ratio as 37.8%, compared with Shanghai (39.4%) and Beijing (34.8%). Besides, the Hangzhou bike lanes are also considered to have the top performance in terms of the partition of the bike lane and the parking area designation (Tan et al, 2015).

Besides, the government also has shown a positive attitude. According to Hang and Jun (2011), in 2007, Hangzhou government proposed the construction of the slow traffic system. Hangzhou is one of the earliest cities in China to start the construction of urban slow traffic system. Slow traffic system refers to the transport system that includes walking and slow-speed non-motor vehicles. The aim of implementing the slow traffic system is to change people's reliance on

private cars, which advocates people to adopt the multi-system transport such as " walking plus biking" or " biking plus bus" (Hang and Jun, 2011). According to Yu et al (2009), in the "Hangzhou Slow Traffic System Planning" published in 2008, the government proposed the idea of constructing a comprehensive network of non-motor vehicle lanes including 59 broadwise bicycle corridors and 66 endwise bicycle corridors by the year of 2020 with the total length of 1130 km. It is expected that these non-motor vehicles could closely connect with the urban railway transit system, Rapid Bus Transit system and regular bus system in the future. One emphasis of the Planning is to construct slow traffic system in the key scenic areas and alongside the river. For instance, the government proposed the construction of 25 non-motor vehicle lanes with a total length of 65 km around the West Lake scenic area. The government expected that these non-motor vehicle lanes could combine with the footpath to provide a safe and quiet vibe to the surrounding area of the West Lake (Yu et al, 2009).

## 5.3 Conclusion on the regime and landscape analysis

The appearance of the internet bike in China could be seen as a result of several landscape changes. The prevalence of mobile payment paved the way for the sudden emergence of the internet bike system. To conclude on the regime and landscape analysis, it is believed both landscape and Hangzhou mobility regime offer a favorable environment for the development of the internet bike rental.

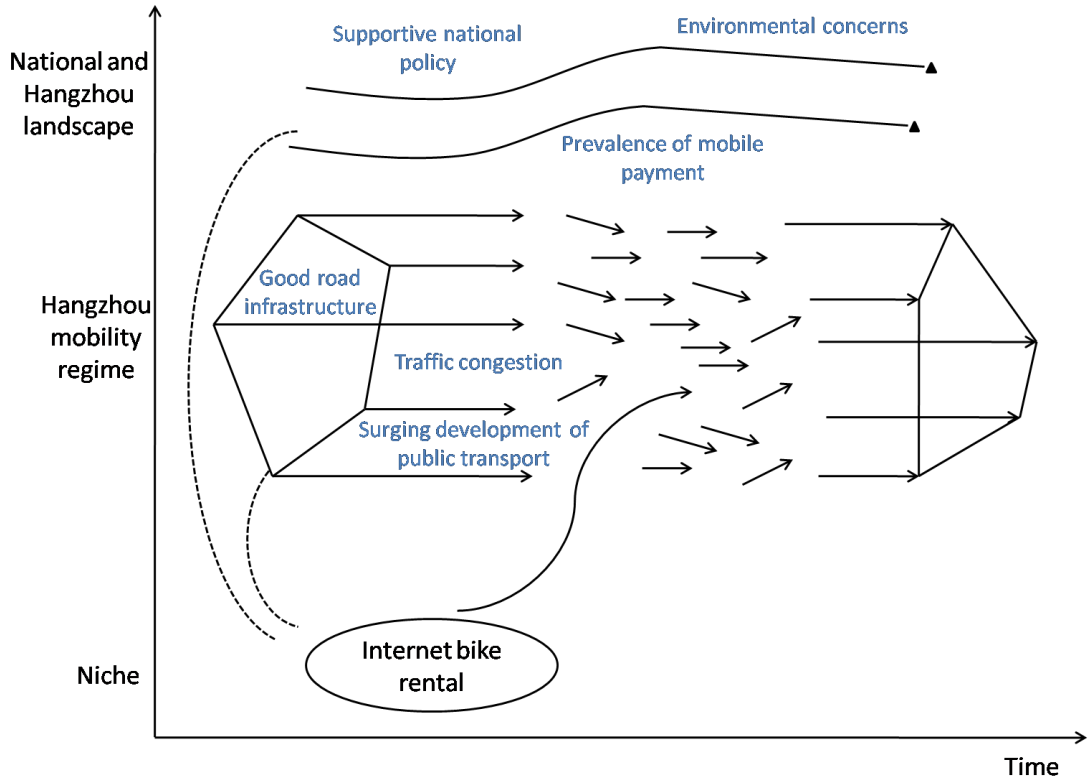


Figure 5.2. Multi-level perspective on internet bike system in Hangzhou (Adapted from Geels, 2007)

At the landscape level, a number of landscape factors are considered to be favorable to the development of the internet bike rental, such as the supportive national policy, the needs for new economic momentum and the growing environmental concerns. At the regime level, although the current Hangzhou mobility regime is locked by the steady user demand of private cars and well-developed automobile industry. The future Hangzhou mobility regime is considered to be positive for implementing the internet bike system due to the increasing traffic pressures, surging growth of public transport and well-planned urban slow traffic system. Figure 5.2 is made to clearly illustrate the main landscape and regime characteristics. It is believed that the internet bike rental currently is adopted as a part of the public transport system in Hangzhou mobility regime.

# 6. Niche analysis

Strategic niche management is applied to analyze the development of the internet bike rental in Hangzhou. In this chapter, the historical development of the internet bike rental in Hangzhou is first analyzed in section 6.1, which is divided into two phases. The current development of the internet bike rental is the focus of this study and is elaborated and analyzed in section 6.2. The issues in the current development of the internet bike rental and the suggestions are identified in section 6.3. The outcome of this chapter could be used to answer the sub-questions: Who are the stakeholders involved in the internet bike rental and how did these stakeholders foster the development of the internet bike rental? What issues does the current internet bike rental encounter and how could these issues be solved?

## 6.1 Historical development of the internet bike rental

### 6.1.1 The first phase

The first phase started from September 2016 when ofo started to operate on the campus and ended when Qibei (another internet bike company) started to operate internet bike system in Hangzhou city in November 2016. In this phase, the internet bike system was only operated on campus.

#### Network

As the initiator of the dockless bike-sharing business, ofo is also the first company that entered Hangzhou. Their operation started from September 2016, but initially only on campus (Zhang, 2016). The users (students and faculties) and the bike company (ofo) were the only stakeholders since the company only provided bike rental service to the college students and staffs. A few maintenance staffs were designated to manage the maintenance and redistribution of the bikes (Wang, F., 2017). The small-scale operation didn't draw much public attention since the internet bike system hasn't caused any troubles to the society.

#### Expectation

There was hardly any shared expectations between the users and ofo. According to Wang, F. (2017), ofo raised a high expectation that the internet bike could offer an alternative mode of travel on campus, provide more clean and comfortable campus environment, and eventually stimulate the students sharing their own bikes. ofo had a clear strategy on how to realize this expectation. Their short-term strategy was to release more bikes, the mid-term strategy was to

clean out the abandoned bikes to provide more comfortable campus environment, and the long-term strategy was to enhance the collaboration with the students to promote them sharing their own bikes (Wang, F., 2017). However, this expectation is mainly based on company's wishful thinking and wasn't shared by the students. The students only saw the internet bike as a good alternative travel method for the short tips on campus but had no intention to share their own bikes.

### Learning

During that time, the internet bike company didn't have much experience with the operation of the internet bike system. According to Wang, F. (2017), most of the lessons in this phase were related to the management of the location of the bikes, which includes allocating and redistributing of the bikes based on the demand in different places. The fluctuant demand and irregular flow pattern of the bikes caused the imbalance of the bikes in different places. In order to ensure there are enough bikes in the places where the demand is high, a number of operational staffs needed to collect the bikes by themselves and redistribute the bikes to different places based on the calculated demand. However, the management method was quite conventional back to that time. Because the bikes were not equipped with GPS chip, the collection of the bikes consumed a lot of human resources (Wang, F., 2017). But thanks to the system was operated in a relatively closed and small environment, the students (interview with user type A, 2017, see quote 1, Appendix C) recalled that most of the bikes are managed and placed in a good order.

## 6.1.2 The second phase

The second phase started from November 2016 when more bike companies joined the market and started to operate in Hangzhou city. This phase ended in March 2017 when the parking of the internet bikes caused serious traffic issue and the government started to regulate the development of the internet bike rental. During this phase, the internet bike companies still lead and dominate the development of the internet bike rental.

### Network

On Nov 3, 2016, Qibei Tech, a local bike-sharing startup, became the first company to operate this dockless designed bike system in Hangzhou city (Qibei official, 2017). The explosive growth of the internet bike companies in Hangzhou started from the beginning of 2017, several internet bike startups began to launch their bikes in Hangzhou city, including Haluo Bike (January 2017); ofo (February 2017), Xiaoming bike (February 2017) (Tang, Zhou and Zhang, 2017). In the earlier phase, all these companies were putting a lot of efforts to increase their market shares by

increasing the number of their bikes. Their potential users were no longer limited to the students, which all the Hangzhou citizens got access to the internet bikes. It is believed that the internet bike companies and the users were still the dominant stakeholders in this phase.

During that time, Hangzhou government held a wait-and-see attitude and had no intention to build a close relationship with the bike companies. This caused the internet bikes (especially the bike parking) were managed in a rather passive manner. *The Hangzhou Municipal Administrative and Law Enforcement Bureau* (the subordinate body of *Hangzhou Municipal Commission of City Administration*) and *the Traffic police detachment of Hangzhou Public Security Bureau* are the only two government entities that have some relations with the internet bike rental. The law enforcement officials from these two government entities occasionally confiscated the illegally parked bikes if the bikes had affected the traffic (Chen, 2016). Back to that moment, the government hadn't established a comprehensive system for the management of the internet bikes, most of the currently involved government entities were outsiders. Besides, a wide range of media coverage hadn't started since the problem wasn't very serious at that moment. Most of the researchers also hadn't actively involved in this phase.

## Expectation

In this phase, the expectation of the market potential of the internet bike was high which attracted a lot of investments for these internet bike companies (iResearch, 2017). Many bike companies started to launch their bikes in Hangzhou. They raised the expectation that the internet bike could solve the problem of last mile connection to the major transit (Finance.sina.com.cn., 2017). More specifically, the internet bike companies in Hangzhou expected the internet bike system would corporate with the public bike system to construct a more comprehensive bike sharing system in Hangzhou (Wo men yuan zhuo hui, 2016).

The internet bike companies were putting a lot of efforts on advertising the idea of "sharing". During that time, the internet bike was called "shared bikes", which the companies acclaimed that the bikes could offer an effective solution to the traffic congestion and environmental emission caused by the excessive use of private cars. This expectation was shared by most of the Hangzhou citizens. They held a positive attitude towards the internet bike system and believed that this newly-emerged bike sharing system has the potential to bring positive social and environmental impact (Wo men yuan zhuo hui, 2016). However, a few researchers doubted the expectation raised by the internet bike companies, they had pointed out that potential problems (bike parking, safety) would emerge in the operation of the internet bikes system (Wo men yuan zhuo hui, 2016).

## Learning

Due to the super cheap price and the extreme convenience the internet bike system brought, the

internet bike rental attracted a huge amount of the users immediately, which promoted the bikes companies to push a massive plan of bike manufacturing. The learning in this phase was mainly focused on the technical aspect of the bikes. Different companies had generated different lessons on this aspect, but more or less, the lessons on this aspect include more advanced bike lock (faster unlocking time), lighter bike weight, new braking system and more resistant tires (Han, 2016).

Take ofo as an example, according to Kejiquannei (2017), the first generation of ofo's bike didn't distinguish it from the regular bike. It is worth noting that the bike lock in this generations is the mechanical lock, which wasn't equipped with any information technologies (see Figure 6.1). By scanning the QR code in the front of the bike, the combination of the lock will be displayed on the users' smartphone, which the users have to manually line up the numbers to unlock the bike. One drawback of this kind of lock is the combination of each lock is fixed. So if the user does not realign the lock, the next user could use the bike directly. This lock had caused many problems since the users could more easily take the bike for personal use. After several times of improvements, now this kind of lock has gradually been eliminated. The smart lock was applied which can open automatically after scanning the QR code. Besides, the following generation of ofo's bike was also equipped with GPS chips, enabling the users to easily find the nearby bike through the map feature in its app. (Kejiquannei, 2017). Besides, Some of the lessons related to the technical aspect of the bike were stimulated by the complaints from the users. For instance, according to (Alexa, 2016), Mobike had launched an improved version of their bikes - "Mobike Lite". This new version of their bikes is cheaper and lighter which was stimulated by the users' complaints of the bikes are too heavy to ride.

Figure 6.1. The combination lock applied on the ofo's bike (Pictured taken by author)

There were not many lessons learned from other aspects in this phase. According to Wo men yuan zhuo hui (2016), most of the researchers and citizens hold a welcoming but cautious attitude since they were not familiar with this newly-emerged bike sharing system. There were

some lessons learned from the industrial development aspect. For instance, Qibei decided to release the first batch of their bikes in the relatively remote areas (Binjiang district) to avoid the face-to-face confrontation with the public bike system (Wo men yuan zhuo hui, 2016).

## 6.2 Current development of the internet bike rental

The current development of the internet bike rental started from March 2017 when Hangzhou government began to actively participate in the management of the internet bike rental. In this phase, the government has become the dominant actor and exerts a great influence on the development of the internet bike rental.

### 6.2.1 Network formation

#### Network Dynamics

The current development of the internet bike rental (the third phase) started from the end of March when the internet bike system caused serious traffic problems. On March 26, 2017, thousands of internet bikes poured into the West Lake scenic area: Hangzhou's most famous tourist attraction. These bikes were parked outside the south entrance of Su Causeway which led to massive traffic jam lasting for an hour (CZTV, 2017). It was not just an accident. In Qingming Festival, the internet bikes again besieged the surrounding area of West Lake and caused serious traffic congestion (CZTV, 2017). These issues had attracted a lot of attention from the local media and the researchers in the relevant field. Besides, Hangzhou government also realized the seriousness of these issues and started to play an important role in the development of the internet bike system. The currently involved government entities include *Hangzhou Transportation Bureau*, *Hangzhou Municipal Commission of City Administration*, and *Hangzhou Municipal Bureau of Public Security*.

It is evident that the media in Hangzhou has become the driving force of letting the "internet bike problems" being seen. The constant coverage of these problems by the local media raised the social awareness and stimulated the active participation of the researchers. Based on Wo men yuan zhuo hui (2017a), the peak of the researcher's participation was in April 2107. Back to that time, a lot of researchers brought up their proposals and suggestions about the management of the internet bike rental to Hangzhou government. The reason is that it was the time when Hangzhou NPC & CPPCC meeting was held. These two annual meetings provided a good platform for researchers to articulate their opinions about the future management of the internet bike rental. However, after April, most of the researchers (mostly the members of Hangzhou committee of the CPPCC) are no longer paying as much as attention to the internet bike rental. When these two meetings were over, most of the researchers lacked the motivation of continuing carrying on the research on the internet bike rental.

More internet bike companies entered Hangzhou during that time. Another internet bike industry leader Mobike entered Hangzhou in April (Yang, Q., 2017). The tripartite confrontation of three internet bike companies (ofo, Mobike and Haluo bike) began to take shape. The peak of the number of the internet bike companies was in July when there were in all 9 internet bike companies in Hangzhou (Yang, Y., 2017). The number of bikes was also increasing at an astonishing speed. Until July 2017, there were in total 418 thousand internet bikes that had been released in Hangzhou (The office of Hangzhou internet bike management leading group, 2017). Due to the serious parking issue, the internet bike companies are forced to take care of the bike parking. They started to hire more maintenance staffs and the people from logistics companies to manage the distribution and the parking of the bikes, especially during the public holiday and in some busy areas.

The future dynamic of the network could be referred to as more government entities would be involved and more internet bike companies would leave the market. Firstly, because of the urgent need to resolve the negative societal impact caused by the internet bike rental, more and more government entities would be expected to be involved in the internet bike rental niche. According to The office of Hangzhou internet bike management leading group (2017), it was said that, in the future, *Hangzhou Municipal Quality Supervision Bureau* would start to drafting the quality standard for the internet bike. Besides, *Hangzhou Municipal Market Supervision Administration* might also participate in regulating the internet bike market (Hangzhou Transportation Bureau, 2017).

However, on the other side, it is evident that more and more internet bike companies would leave Hangzhou. The market competition between internet bike companies is cruel. Not all the companies have the sufficient financial resource to survive. When ofo, Mobike and Haluo bike take up the majority of the market shares, other small companies began to quit this market. While some of these small companies started to do other business, the rest of them went bankrupt. Qibei, the first internet bike companies that operated in the Hangzhou city, had already left the internet bike renting business and devoted themselves to the research of the smart bike lock (Tang, 2017). At the national level, more and more internet bike companies had gone bankrupt due to the lack of sufficient financial resources (Xin, 2017). It is believed that the number of internet bike companies in Hangzhou would also be decreasing at the same time.

## Network composition

Firstly, to understand the current network composition of the internet bike niche in Hangzhou, a stakeholder analysis was performed. Except the investors and bike manufacturers at the national level, in the case of Hangzhou, the current stakeholders include: 1) the internet bike companies (ofo, Mobike and Haluo Bike); 2) the government entities that participated in the management of the bikes (including *Hangzhou Transportation Bureau, Hangzhou Municipal Commission of City Administration, Hangzhou Municipal Bureau of Public Security*); 3) the public bike company in

Hangzhou; 4) the researchers and institutes that have an interest in internet bike or collaborate with the internet bike companies; 5) the users of the internet bike; 6) Hangzhou citizens who are not the users of the internet bike; 7) local media; 8) the logistic companies.

**Investors**

These investors of these bike sharing startups are some big names in IT business as well as some venture capitalists. To name a few, the investors of ofo include Alibaba, ride-hailing giant Didi Chuxing and Ant Financial, while the investors of Mobike include Tencent, Warburg Pincus, and DST Global. Among all these investors, Alibaba and Tencent are the leading ones behind ofo and Mobike respectively. Although they are not among the first batch investors, they both are committed to a large amount of investment and do shape the competition because of their great influence (Liu, j., 2017; Sina Tech, 2017). Suddenly, the competition between two start-up companies become the competition between two most established IT enterprises in China. Apart from the capital investment, Investors like Alibaba, Tencent and Didi Chuxing also allowed their users to rent the internet bikes using their platforms. For instance: you could find rent a Mobike's bike using Wechat app (published by Tencent) or find an ofo's bike through Alipay app (published by Alibaba).

**Bike manufacturers**

According to Li, R. (2017), different companies may collaborate with different bike manufacturers. But most of them opt for collaborating with some big names in the traditional bike-manufacturing industry, such as Flying pigeon, Foxconn, Tianjin Aima, etc (Table 6.1). It is believed that the previous prosperity of the bike industry in China laid a solid foundation for the emergence of the internet bike rental since a number of traditional bike manufacturers are left which provide enough productivities to satisfy the huge demand from the internet bike companies (Li, R., 2017).

| The expected bike yield in 2017 | | | |
|---|---|---|---|
| Mobike | | ofo | |
| Manufacturer | Yield (ten thousand) | Manufacturer | Yield (ten thousand) |
| Tianjing Aima | 500 | Tianjing BATTLE | 1300 |
| Fuxconn | 560 | Flying Pigeon | 480 |
| Self-producted | 500 | Self-producted | 0 |
| In total | 1560 | In total | 1780 |

Table 6.1. The expected bike yield in 2017 of Mobike and ofo (Li, R., 2017)

**The internet bike companies**

Another biggest internet bike startup Mobike entered Hangzhou in April (Liu, Y., 2017). The current internet bike market in Hangzhou has already formed a tripartite confrontation, which

ofo, Haluo Bike, and Mobike become the key players. These three internet bike companies occupy the majority of the internet bike market in Hangzhou (Wo men yuan zhuo hui, 2017c). They become the target groups in this research.

**The government entities**

There are three government entities currently involved in the internet bike rental niche, namely Hangzhou Transportation Bureau, Hangzhou Municipal Commission of City Administration, and Hangzhou Municipal Bureau of Public Security.

1) Hangzhou Transportation Bureau:

Stating on the official website of Hangzhou government (Hangzhou China, 2017), *Hangzhou Transportation Bureau* is responsible for formulating the development strategies and the sector policies of Hangzhou traffic and transportation. They take care of drafting local regulations about transportation administration and are responsible for supervising the implementation of these regulations. Their duties also include the supervision of citywide transportation market which includes the market of all the road and water transportation (Hangzhou China, 2017). With regard to regulating the internet bike system, *Hangzhou Transportation Bureau* is taking the lead. They are in charge of the relevant regulation drafting and are also responsible for facilitating the coordination between the government entities on this issue (Hangzhou Municipal Government, 2017).

2) Hangzhou Municipal Commission of City Administration:

*Hangzhou Municipal Commission of City Administration* is responsible for formulating and implementing local development strategies and plans that are relevant to the city administration. Their daily jobs include the management of the urban infrastructure construction, public utilities, city outlook and environmental sanitation (Hangzhou China, 2017). With regard to regulating the internet bike system, *Hangzhou Municipal Commission of City Administration* is responsible for supervising and regulating the bike parking on the footpath. They are also responsible for the designation of parking places for the internet bikes (Hangzhou Municipal Government, 2017).

3) Hangzhou Municipal Bureau of Public Security:

The responsibility of *Hangzhou Municipal Bureau of Public Security* is undertaking the national and municipal regulations about public security, drafting local regulations, and carrying out the work on the public security in Hangzhou. In respect of transportation, the responsibility of them is to safeguard traffic security, handle traffic accidents, and organize and supervise the traffic order (Hangzhou China, 2017). With regard to regulating the internet bike system, *Hangzhou Municipal Bureau of Public Security* takes charge of regulating the bike vandalism and the illegal acts related to cycling or the bike parking on the road (Hangzhou Municipal Government, 2017).

**The public bike company**

As aforementioned, Hangzhou is renowned for its well-established public bike system. The public bike service is an important part of Hangzhou's "Five in One" public transport system. Hangzhou Public Transport Bicycle Services and Development Co., Ltd (hereinafter referred to as "public bike company") is the wholly-owned subsidiary company of Hangzhou Public Transport Group. It

is responsible for the construction, operation, and management of the public bike system (Hangzhou Bicycle Service, 2012). To use the public bikes, a city IC card or a citizenship card is required.

**The researchers**

Internet bike system has caused a lot of debates among the researchers in the relevant field. At the national level, there are several institutes and universities that collaborate with the internet bike companies with the aim of cultivating talents and publishing quarterly industry reports (Chinanews.com, 2017). In the case of Hangzhou, there are several independent researchers involved in the internet bike rental niche. The composition of the researchers is:

- The members of the Hangzhou committee of the CPPCC (Chinese People's Political Consultative Conference). The local committee members of the CPPCC are recommended and selected by the government on the provincial level, which involves the representatives with the different political backgrounds (The national committee of the CPPCC, 2011).
- Professors from the universities or relevant institutes. The active researchers in this field include Prof. Wu from Zhejiang University of Technology and Prof. Zheng from Zhejiang University school of management.

**Users**

Since there is no evident obstacle of using the internet bike, the market potential of the internet bike rental is huge. The majority of the bike users are young male adults with the average age range of 26-35 (iResearch, 2017). Tourists are also keen to use internet bikes since the internet bikes are more convenient and don't require the city IC card or the citizenship card. The non-users are normally the elderly people. No matter the users or non-users, they are all involved in the internet bike rental niche in Hangzhou. Because of its societal impact, the internet bike system inevitably affects everyone who currently lives in Hangzhou.

**Local media**

The local media in Hangzhou also began to participate in the internet bike rental niche. Both the local television and the local press have started to pay attention to the internet bike rental when the parking issues of the internet bikes caused serious traffic problems. Their role can be identified as the network facilitator who builds the connection between the government entities and the rest main stakeholders.

**The logistics companies**

The logistics companies are responsible for the transportation of the bikes. As aforementioned, the bikes are mainly manufactured elsewhere in China. So normally, they would be transported by a third party logistics company from the production site to Hangzhou. Besides, the logistics companies also take care of the redistribution of the bikes within Hangzhou.

To give an overview of the main participants in the internet bike rental niche. A stakeholder map is drawn which includes all the aforementioned stakeholders. Their relations could be observed from Figure 6.2. As shown in the figure, the bike companies provide the bike rental services to Hangzhou citizens and collaborate with the local logistic companies to manage the bike allocation

and distribution. They receive venture capitals from the investors and acquire the bikes from different bike manufacturers. The public bike company is the main competitor of the internet bike companies, which they also provide bike rental service to Hangzhou citizens. Three government entities are currently involved in the management of internet bike rental, including *Hangzhou Transportation Bureau, Hangzhou Municipal Commission of City Administration and Hangzhou Municipal Bureau of Public Security.* The researchers are involved in the internet bike rental niche by articulating their ideas to the government entities through the facilitation of the local media.

Figure 6.2. The core stakeholders of the internet bike niche (created by author)

## Network alignment

Due to the seriousness of the bike parking issues, Hangzhou government started to take actions. *Hangzhou Transportation Bureau* started to take the lead in the formulation of relevant regulations. *Hangzhou Municipal Commission of City Administration* and *Hangzhou Municipal Bureau of Public Security* also started to actively participate in the management of the internet bike parking. They are starting to designate more parking places for the non-motor vehicles and assign more people to manage the illegal parking (Wei, 2017). The interaction between different government entities is well-managed. *Hangzhou Transportation Bureau* exclusively takes care of the coordination between different government entities which ensures the knowledge and information transferring. Within each government entity, the communication between the staffs is facilitating by building Wechat groups. The people who notice a problem (such as illegally parked bikes) would send a notification to this group so that other people could take action sooner (interview with government entity B, 2017, see quote 2, Appendix C).

Currently, the government, the companies, and the researchers have gradually formed a close relationship which their communication was facilitated through their participation in TV talk shows and several formal and informal meetings (Wo men yuan zhuo hui, 2017a). The Hangzhou citizens (including users and non-users) also participated in some of these meetings. In these TV programs and meetings, the researchers and citizens were able to transfer their knowledge and opinions to the government entities as well as the internet bike companies. Besides, the government used these meeting to explain their requirements (on the operation of the internet bike system) to the internet bike companies. However, the motivation from the companies side is limited, which negatively affected the quality of the interactions. Although the companies did participate in these meetings, they were unwilling to comply with the requirements proposed by the government or share any useful data. Due to the underlying competitive relationship between the bike companies, many companies are really cautious about their information which they have no willing to share with the others. For instance, as required, the companies should accurately report the total number of their released bikes to the government. But It's widely acknowledged that the number reported by the companies is not as accurate as it should be. Even the government acknowledged that the real number of the bikes should be a lot more compared to the current reported number. According to He (2017), the staff from the *Xiacheng District City Administration and Law Enforcement* stated that " I know the real number (of the bikes) is a lot more than (what they reported)." he said, "sometimes when we started to minimize the number of bikes, the companies would say that their previous number is not precise."

At the district level, the bike companies form a closer and more genuine relationship with the government, which their communication is facilitated by regular monthly meetings. For instance, according to the interview with government entity B (2017, see quote 3, Appendix C), in Xihu district, the responsible people from three major bike sharing companies (ofo, Mobike, and Haluo Bike) are taking turns to report the situation of the management of the internet bikes to the district government. The interactions in these meetings are more efficient due to the companies are gaining more motivations. Each of the three companies is responsible for managing not only their own bikes but all the bikes that are parked in the designated area for ten days every month. So once they found that other companies did not comply with the rules, they are more willing to report it to the government.

It is believed that the involvement of users and non-users to some extent promoted the government to take more actions. Their complaints on the bike parking issue are normally handled in priority (interview with government entity B, 2017, see quote 6, Appendix C). However, their opinions are still scattered which need to be better managed and enhanced. Besides, there are also problems in the interaction between users and bike companies. The interaction between the users and the companies is quite limited due to the communication between these two stakeholders were managed in a passive way. For example, the users who encountered a malfunctioned bike need to manually report the problem by themselves. However, the users might lack the incentive of doing so. According to the interviews with user type A, B and C (2017, see quote 4, Appendix C), some of them stated that they won't bother to report the problem and normally just change to another bike. Besides, it should be noted that although the public bike company is the main competitor of the internet bike companies in Hangzhou, there is currently

no tangible interaction (direct communication) between these two stakeholders.

## Conclusion on the network analysis

Three government entities, three internet bike companies, the researchers, local media, public bike company, logistic companies, and Hangzhou citizens have formed the stakeholder network of the internet bike system in Hangzhou. In this network, non-users are involved but their opinions should be better managed. The current communication between the researchers, the government, and the internet bike companies are well organized. However, the quality of the communication might be limited due to the companies are still competing for more market share and lacking the incentive of sharing information. Besides, the communication between users and companies is poorly managed. The future dynamic of the network could be referred to as more government entities would be involved and more internet bike companies would leave.

# 6.2.2 Voicing and shaping of expectations

According to Wo men yuan zhuo hui (2017a), after the internet bike system had caused serious traffic problems, the stakeholders were becoming less convinced by the promising future proposed by the internet bike companies. Instead, the expectations about the social and environmental impacts of the internet bike started to show some signs of turning negative. However, most of the stakeholders still have the belief that the internet bike could contribute to solving the urban traffic problems and environmental protection if it is well-managed (Wo men Yuan zhuo hui, 2017a, 2017b, 2017c). This expectation stimulated a lot of learning processes, which mainly focus on future policy drafting and how should the government supervise and manage the internet bike companies. This expectation will be further elaborated in the *Social and environmental aspect* section. Before that, the current expectations are first analyzed from technical aspect, industrial aspect and policy aspect.

## Technical development and infrastructure

First, on the technical aspect, the government has the expectation that the application of the information technology could contribute to the effective management of the internet bike system (Wo men yuan zhuo hui, 2017c). The government currently is in favor of two specific technologies, which are the electric fence and monitoring platform. They have already started the pilot experiments to test the effectiveness of these two technologies (Dushikuaibao, 2017).

Hangzhou is the first city to apply "monitoring platform" technology to the management of the internet bike system (Wo men yuan zhuo hui, 2017c). Due to the fact that the companies themselves lack the initiative to improve the management of the bike system, Hangzhou

government had decided to connect the data of internet bikes (such as the position of each bike, the number of the bikes and the trajectory of users riding the bike) to the monitoring platform. This technology is also expected to supervise the capital (deposit) flow of the internet bike companies in the future (Dushikuaibao, 2017). However, the experiment of this technology is still in its initial phase. There haven't been any tangible results generated from it. Besides, the connection of the data still needs the cooperation from the company side. The bike companies themselves need to connect all their data to the platform, their incentives are still doubtful.

Another technology is the electric fence. It is believed that the nationwide application of electric fence stimulated the creation of this expectation. However, the implementation of this technology didn't generate many positive results, which will be further elaborated in the section 6.2.3. In fact, the result was quite negative. As for the implementation of electric fence in Beijing, because the bike companies didn't have a well-established reward and penalty scheme, some of the users still didn't have the intention to park the bikes in the designated area (Sina.com, 2017).

To conclude, the quality and robustness of this expectation are not optimal. The expectation of alleviating the current regime problem by applying aforementioned technology is mostly driven by the theoretical assumption. There haven't been many positive or tangible results generated from the experiments. Besides, this expectation hasn't been widely shared by other stakeholders (Wo men yuan zhuo hui, 2017). Although most of the researchers and users are supportive of the application of these technologies, they are not fully convinced that these techniques could improve the bike management. Some researchers and users held a " better than nothing" attitude (Wo men Yuan zhuo hui, 2017c). Their expectations on these technologies still wait to be enhanced by the learning results. It is still too soon to be optimistic that these technologies could contribute to a significant improvement of the parking issues.

## Industrial development

On the industrial aspect, there is a widely shared and acknowledged expectation, which is the number of the internet bike companies operated in Hangzhou would decrease in the future. This expectation has been confirmed by several stakeholders in different ways. Researcher A believed the internet bike companies would be merged by the government in the future (interview with researcher A, 2017, see quote 7, Appendix C). The government expected to see only one or two internet bike companies would operate in Hangzhou, which the internet bike system and public bike system would build a mutually reinforcing relationship in the future (interview with government entity A, 2017, see quote 8, Appendix C).

This expectation has a negative impact on the companies' behavior. This negative vision has induced the excessive competition between the companies and caused the bike parking issue could not be effectively solved. The internet bike companies are afraid that they might lose and are all trying to grab more market shares. This explains why the companies' strategies didn't align with the government's requirements. For instance, one of the main business strategies of the

internet bike companies is releasing more and more bikes to attract the potential users. That's why even when the government had made it clear to the companies that no more bikes are allowed to be released, the companies still tried to release more bikes privately.

This expectation is supported by several factors. **Firstly**, at the national level, the investors have the intention to push ofo and Mobike into merger (Chen, Y., 2017). Although this intention was denied by both companies, the people still believed in this cash burning battle won't last long. One of the supporting evidence of this expectation is the merger between Didi Chuxing and Uber China. These two Companies went to the merger after the government published the regulations to regulate the E-hailing business (Li, 2016). **Secondly**, there have been several internet bike companies that went bankrupt (Xin, 2017). The competition between these bike companies is intense. As aforementioned, it is evident that the biggest two bike companies (ofo and Mobike) are dominating the current market. The bike companies without sufficient fund have gradually gone bankrupt (Xin, 2017). **Thirdly**, the researchers and the government all have the intention to control the rapid expansion of the internet bike system in Hangzhou. They have a clear view of what should be done. Such as the researchers had advocated that government to publish more strict standards to evaluate the service of each company provides and eliminate the companies that don't comply with the standard (Wo men yuan zhuo hui, 2017a, 2017b).

## Government policy and regulatory framework

The current expectation on policy aspect is that more methods and regulations would be applied and published by Hangzhou government in the future. This expectation is mainly supported by the government attitude and actions. After the internet bike system began to show some issues, the government has published several guiding opinions (regulations) and has taken different measures to manage the bike parking (more in section *6.2.3*). In the future, the government also has the intention to publish more regulations to improve the performance of the internet bike system. According to the interview with government entity A (2017, see quote 9, Appendix C), it is expected that many other regulations to be published. These regulations involve the regulation to enforce the registration of the bike, the regulation to force the companies to complete their business registration in Hangzhou, and the quality standards on the internet bikes and the services provided by the bike companies. However, no clear date was announced by the government about when these regulations will be published.

Currently, the government doesn't think it is necessary to regulate the internet bike system with the regulation with legally binding force (The office of Hangzhou internet bike management leading group, 2017). Although the governments also want to see the problems caused by the internet bike rental being reconciled, they believe that it is unnecessary to publish any legally binding regulations at this moment when there are still many uncertainties in the market (interview with government entity A, 2017, see quote 9, Appendix C). This factor might affect the robustness of the expectation of more regulations being published in the future and limited the restricting effect of the regulation on companies' behavior.

## Societal and environmental impact

As aforementioned, most of the stakeholders still believe that the internet bike system could be extensively implemented in the city and could contribute to environmental sustainability and solve the urban traffic problems if it is managed well. In another word, they hold an expectation that the internet bike rental has the potential to be implemented on a large scale and exerts positive environmental and social impacts at the same time (Wo men yuan zhuo hui, 2017c). This expectation has been widely shared by most of the stakeholders. The government and the companies all have clear strategies to help the healthy development of the internet bike system.

This expectation is supported by the many factors: **Firstly**, there is a common belief that the internet bike rental itself is still an environmental-friendly and healthy travel method which can also help to relieve the traffic pressure. The stakeholders learned that the current problem is mainly caused by operating model of the bike companies which have the potential to be improved. **Secondly**, this expectation is also enhanced by the encouraging attitude held by the national government. As shown in the "Guiding Opinions" published by the national government, the national government also acknowledges the potential positive impact that the internet bike system could contribute to the urban transportation (The Ministry of Transport, 2017). **Thirdly**, internet bike rental surely has provided a convenient method for the short distance travel and has stimulated more people to take the public transport (Mobike white paper, 2017). **Fourthly**, there is a shared expectation that the current illegal parking issue would be improved by the government, which means that the citizens in Hangzhou would have a direct feeling that the situation of the bike parking is better (The office of Hangzhou internet bike management leading group, 2017).

However, it has shown some signs that this expectation (the internet bike rental has the potential to exert a positive impact on environmental and social aspect) might not be very robust. Some government entities, especially *Hangzhou Municipal Commission of City Administration* since they directly manage the illegally parked bikes, are gradually losing faith because they have spent many resources to regulate the internet bike system (Wo men yuan zhuo hui, 2017c). Besides, the attitude of researchers also is not very supportive, such as Researcher A believed that the dockless designed internet bikes could only cause trouble to the urban management (interview with researcher A, 2017, see quote 7, Appendix C). This expectation is considered to be too optimistic. Because there haven't been any proofs showing that the internet bike could be successfully implemented on a large scale. The current profit model and the competition between the companies all create potential barriers to realize this expectation. But overall speaking, this expectation is not affected much by these negative factors and is still considered to be positive to the development of the internet bike system.

## Conclusion on the expectation analysis

The current expectation on different aspects could be concluded as follows. Three widely shared expectations are considered to have the most significant influence on the internet bike development. First, most stakeholders still believe in that the internet bike has the potential to be extensively implemented and bring positive social and environmental impacts. This expectation hasn't been much affected by the current parking issues because the stakeholders believe that the current problems are rather caused by the operational model than the bike system itself. Secondly, the stakeholders also share an expectation that the number of the internet bike companies would decrease in the future. This expectation has a good quality which is supported by the actions of Hangzhou government and the landscape changes. However, this expectation is considered to only intensify the competition between the internet bike companies. Thirdly, the stakeholders also believe that there would be more methods and regulations published in the future. Apart from that, the government holds an expectation that the application of the information technology could have the potential to alleviate the illegal parking problem. However, this expectation is mainly driven by the theoretical assumption and need to be validated by more experiments in the real world.

In all, it is reasonable to conclude that Hangzhou government has a great influence on all these expectations. It is evident that the future expectation is pretty much determined by the government attitude and actions, which indicate that the government will gradually take over the future development of the internet bike. However, the cooperation from the company side still remain a problem, their actions would still differ from the government's requirements unless the regulations with legally binding force are published in the future.

# 6.2.3 Learning Process

## Technical development and infrastructure

The learning about the bike design was still continuing. While Mobike continued to launch their new version of Mobike Lite, ofo still focused on the bike lock improvement. In November 2017, ofo announced the release of the NFC smart lock and NB-IoT internet smart lock. They stated the new NFC lock can substantially reduce the time of unlocking the bike and the NB-IoT technology can contribute to enhancing the network signal (China.com, 2017). According to the interviews with user type A (2017, see quote 10, Appendix C), It is interesting to note that the users currently don't have many complaints about the bike design. It is mainly because the bike condition has been improved and the users normally don't have high requirements in this aspect. Overall speaking, the learning about bike design was sufficiently conducted and have generated a fruitful result.

The parking issues become more and more serious in most of the cities with the internet bike

system. This pressure facilitated the learning of the "parking technology". At the national level, the companies have conducted several pilot experiments to test the feasibility of electric fence (Sootoo, 2017). The implementation of the parking technology was first brought up by the researchers and the government with the aim of solving the illegal parking problems. It has received an active reaction from the bike companies. The pilot experiments were first conducted in some first-tier cities on a small scale and had gradually spread to some second-tier cities such as Chengdu and Xi'an (Zhang, 2017). For example, Mobike has launched its "Smart Mobike Preferred Location" system, which they acclaim the system could sense the nearby bikes and estimate the number of bikes in the area and exchange this information with "Smart Mobike Artificial Big Data Platform", so the information will be continually updated and allow the companies to do the adjustment and improvement (Sootoo, 2017). In Beijing, the government also launched its own electric fence system. However, as aforementioned, the result from the pilot experiment is not satisfactory (Sina.com, 2017). The reporter had visited several recommended parking places and found that there was hardly any bikes parked in these areas. Hangzhou government started the pilot experiments of electric fence in December. Among the firstly built 38 electric fences system, each of the systems has the capacity of containing 40 bikes, in which twenty of them is for the parking of internet bikes. The rest is for all the other non-motor vehicles (Hangzhou.com, 2017). ofo, Mobike and Haluo Bike all participated in this trial experiment in Yanan Road. However, since this experiment just started, the results still remain unknown.

Apart from the electric fence, the companies also learned to solve the illegal parking through the application of the big data. Nearly all the current operated bikes are equipped with the GPS chips. So based on the location of the bikes, the companies stated that they could identify the "crowded" area and help them to make responses. Besides, as aforementioned, Hangzhou government had decided to connect the data of internet bike to the monitoring platform, which is expected to make the management of the bike easier (Wo men yuan zhuo hui, 2017c). However, the application of these parking technologies is still in the experimental phase, there haven't been any lessons on whether these technologies are effective or not.

## Industrial development

The learning on the industrial development aspect includes the lessons about different industrial sectors including bike production, bike system operation, and bike maintenance.

About the production of the bikes, all the companies, especially ofo and Mobike, are trying to push massive plans of manufacturing and deployment. It is interesting to note that the production of the bikes is not driven by the real user demand. All these bike companies are trying to attract the potential customers by providing as many as bikes to ensure their bikes could be easily found. "It doesn't matter whether the bikes are broken or being confiscated by the government ", according to Wo men yuan zhuo hui (2017a), " Because the bike companies are backed up by ample financial resources from the investors, they just release more bikes and don't

really care about these bikes". However, there is some research about how the internet bikes could make economic sense conducted by the researchers and institutes (CNR, 2017). The researchers doubt whether the internet bike companies have the ability to achieve profitability based on their current low price strategy and high broken rates of the bikes. But currently, as for the big companies such as Mobike and ofo, this issue didn't draw much attention from them because of they are still supported by a huge amount of investment.

The lessons about the operation of the bike system were mainly related to two aspects: in what way are the companies going to conduct their business in Hangzhou and how should the deposit being managed. According to Wo men Yuan zhuo hui (2017a), the researchers learned that most of the current internet bike companies hadn't completed their industrial and commercial registrations in Hangzhou. So they proposed that every company that wants to operate in Hangzhou must open their branch companies here. The researchers believed that this change would give the local government more power to regulating the companies' behaviors. Besides, the researchers also believed that all the bikes need to be registered as well. About the deposit management, the researchers are worried about the sudden bankruptcy of the companies may cause the refund of the deposit become a problem. They proposed that the deposit should be supervised by a third party to ensure its safety (Wo men yuan zhuo hui, 2017a).

There are few lessons on the maintenance of the bikes. There is no evidence that the broken bikes are well taken care of by the companies. Since there are still lots of bikes that are damaged or broken, the users complained that the bike companies didn't really carry out regular maintenance works (interview with user type A, B and C, 2017, see quote 4, Appendix C). Since the current business strategy of the companies is still enhancing their market share by releasing more bikes, It is apparently difficult for the maintenance to catch up with at the moment.

## Societal and environmental impact

The lessons about the environmental contribution are mainly used for the publicity for the internet bike rental. As aforementioned, the companies have collaborated with different institutes which they acclaimed the environmental contribution of the internet bike rental is huge (Mobike white paper, 2017). For example, In the cooperation between Mobike and China Academy of Transportation Science, Mobike acclaimed that 380 thousand of patrol has been saved in the 36 cities in China since the emergence of Mobike. Besides, according to the statistics, Mobike also contributes to the $CO_2$ reduction of 1.13 million tons, CO reduction of 320 thousand tons, THC reduction of 73 thousand, and NOX reduction of 29 thousand tons (Mobike white paper, 2017). However, there is no detailed information about what these data is based, the validation of these statistics is questionable. Besides, due to the current excessive production model, the real environmental impact of the internet bike rental might not look as good as it is shown in the report.

In the case of Hangzhou, the learning about the social impact is mostly focused on the bike

parking issue, which generated several lessons. The researchers emphasized that the total number of the bikes should be limited (Wo men yuan zhuo hui, 2017a). They learned that the number of bikes was increasing too fast which need to be stopped before the real demand was calculated. However, in some aspects, the opinions between the researchers were not very well aligned. For example, according to Wo men yuan zhuo hui (2017a), researchers believed that there was no need to designate more parking places for the internet bike since it was not very clear how many bikes are really needed. But most researchers believed that more legal parking places for the bikes should be designated and more clear instructions should be provided to guide the users to park the bike in these places. The government has begun to take actions to designate more parking areas for the non-motor vehicles (Wei, 2017). They and the companies also began to assign more staffs to help with the management of the bike parking.

Besides, researchers also led the learning of the safety issue related to the bike use (Wo men yuan zhuo hui, 2017a). According to the interview with researcher B (2017, see quote 11, Appendix C), one of her concerns is who should be held liable when the mechanical problems lead to injuries or even worse. Besides, researcher B also concerned about the user's unfamiliarity of the bikes and the lack of the regular upkeep of the bikes. Generally speaking, the lessons on the safety issue could be concluded as the quality of the bike needed to be better standardized and the condition of the bike need to be regularly checked (Wo men yuan zhuo hui, 2017a).

## The development of user context

These are few lessons on the user context of the internet bike rental. The companies learned the difficulties that the users encountered in a passive way. The lessons are not many since the users lack the incentive to report the problem to the companies (interview with user type A, B and C, 2017, see quote 4, Appendix C). In Hangzhou, companies only learned the user's preference for their business purpose. Mobike entered Hangzhou later and doesn't operate as many as bikes compared to its rivals. In a recent questionnaire that Mobike sent to their registered users, they were trying to find out if the deposit exemption would affect user's behavior (of choosing which company's bike) and asked if the respondent would choose Mobike if no deposit is needed.

According to the interviews with user type A (2017, see quote 10, Appendix C), the difficulties that the users encountered cover a lot of aspects. Among all those difficulties, the complaint of the bike's condition is the most prevalent one, which the main problem is the malfunction of the bikes. (interview with user type A, 2017, see quote 10, Appendix C).

## Government policy and regulatory framework

The top concern of researchers was about the lack of sophisticated regulations. In the earlier phase, because the internet bike system is a completely new social innovation, there weren't any

regulations that specifically targeted at the internet bike rental. Due to the serious parking problems, the researchers strongly urged the government to establish a comprehensive regulation system to implement the aforementioned lessons ( capping the number of bikes, deposit supervised by a third party, standardizing bike qualities, industrial and business registrations). Besides, it is believed that some of the experience from other cities such as Shanghai and Nanjing also provided the knowledge for Hangzhou government to formulate their own regulations since these cities started managing the internet bike system sooner than the Hangzhou government and had generated some experience (Wo men yuan zhuo hui, 2017a).

In April 2017, after attending several meetings with the internet bike companies and listening to the suggestions proposed by the researchers, Hangzhou Transportation Bureau published " The Exposure Draft of Stimulating the Regulatory Development of Internet Bike Rental in Hangzhou " (Hangzhou Transportation Bureau, 2017). In this exposure draft, Hangzhou government first brought up the idea of "government supervise platform, platform supervises users", which the platform refers to the internet bike companies. Besides, the exposure draft set the ratio of the number of operational staffs to the number of bikes as 80:1.

In August, the Ministry of Transport and other 10 ministries in China published "The Guideline of Stimulating the Regulatory Development of Internet Bike Rental (shared bikes)" (The Ministry of Transport, 2017). The guideline acknowledges the active role internet bike plays on several aspects, including satisfying the travel demand, effectively solving the "last mile" problem of urban traffic, alleviating traffic congestion, establishing a green transport system, and promoting the development of sharing economy. This guideline proved that the attitude of the national government is favorable to internet bike development.

At the end of September, the Hangzhou government published the improved version of the previous "Exposure Draft", which is the "Guiding Opinions on Stimulating the Regulatory Development of Internet Bike Rental in Hangzhou" (Hangzhou Municipal Government, 2017). After publishing the first "Exposure Draft", Hangzhou Transportation Bureau had collected opinions from other government entities and also from the public. During that time, the " Exposure Draft" was modified according to over 407 suggestions from the public and more than 20 suggestions from other government entities (The office of Hangzhou internet bike management leading group, 2017). Overall, the "Guiding Opinions" purposes the strategy of stimulating the convergent development of internet bike system and public bike system. The "Guiding Opinions" also encourages the companies to form an information-sharing alliance. Besides, the ratio of the number of operational staffs to the number of bikes has changed to 120:1, which is based on the experience learned from the management of the public bike system. However, It should be noted that all these published regulations don't have the legally binding force.

There are three factors that have the influence on the policymaking for regulating the internet bike rental in Hangzhou: 1) the researchers' suggestions; 2) the experiences from other cities; 3) the guideline published by the national government in August. Among these three factors, it is believed that the attitude from the national government has the most predominant influence on

the local policy drafting, as the "Guiding Opinions" issued by Hangzhou government has a lot of similarity with "The Guideline" published by the national government.

### Conclusion on the learning analysis

Overall speaking, the learning on the aforementioned aspects has generated several lessons, especially on the policymaking. But most of the suggestions proposed by the researchers still waited to be implemented by the government. In detail, the learning processes in the internet bike rental niche could be described as 1) There have been a lot of improvements on the bike design. But the learning about the "parking technologies" was still in the experimental phase and haven't generated many lessons. 2) It has been learned that the bike malfunctions is one of the biggest issues that need to be solved. However, it didn't promote any remarkable improvements from the company side. 3) The learning about the societal impact (parking and safety) and about industrial development (company registration, deposit management) was led by the researchers which generated a fruitful result. However, these lessons still waited to be implemented by the government. 4) The learning about the policy framework has also generated fruitful results (two regulations has been published).

## 6.3 Results and analysis

### 6.3.1 The current issues of the internet bike rental

The internet bike rental could be described as a protected market niche. The functionality of the internet bike system has shown much certainty but it is protected by the huge amount of investments. The development of the internet bike system in Hangzhou is still in the early phase. The niche analysis has also generated some useful insights. **Firstly**, the interaction between the governments and the bike companies didn't promote much progress on solving the current issues (too many bikes, bike parking issues, deposit safety issues, etc). Although the government has arranged several meetings with the internet bike companies, the effect was not optimal. The companies still lack the incentives of complying with the government's requirements because these requirements could impede their business growth.

**Secondly**, the communication between the users and the bike companies is limited. Although the users have been involved in the internet bike rental niche, their opinions are not well articulated. In this study, it is found that the companies didn't pay enough attention to the maintenance of the bikes. There is a mismatch between the user requirements and the focus of the companies. As aforementioned, the companies are still putting a lot of efforts on the improvement of the bike design (such as on the bike lock, bike tire, bike frame). However, the users don't have many complaints on these aspects, instead, the users are more concerned with the problem such as bike malfunctions and the quality of each bike.

**Thirdly**, since the government still holds an open attitude to the development of internet bike, It leaves the internet bike system enough space for adjustment and refinement. However, the expectation that the internet bike rental has the potential to exert a positive citywide environmental and social impacts might be too broad and optimistic, especially when the issues caused by the wide-scale implementation of the internet bike system still linger and could not be effectively solved. **Besides**, since there is a shared expectation that the number of the internet bike companies in Hangzhou in the future would decrease. It has caused excessive competition between the companies. This is considered as the origin of most of the current issues.

**Fourthly**, although there are fruitful lessons on the policy aspect, the published regulations didn't pose strict limitations on the companies' behaviors since these regulations don't have the legally binding force. **Besides**, there are several issues and uncertainties related to the current industrial and business model of the internet bike rental. The internet bike companies currently haven't found the right profit model. They are largely relying on the venture capitals from the investors. However, this business model couldn't last long and might become a potential uncertainty for the future development of the internet bike rental. For example, the current bankruptcy of some internet bike companies has already caused deposit return becoming an issue (Guangzhoucankao, 2017). There is also a big problem in the industrial model of the internet bike rental. All the bike companies are trying to attract the potential customers by providing as many as bikes. This has caused too many bikes in the city and the imbalance between the supply and the actual demand. **At last**, the lessons on the environmental contribution of the internet bike rental are not convincing. The research (of the environmental contribution of the internet bike rental) was mainly carried out by the bike companies themselves. It is evident that the current excessive production model doesn't comply with the aim of the bike sharing. However, the companies didn't address this issue in their research.

## 6.3.2 Suggestions for its future development

In the case of Hangzhou, since the current social impact of the internet bike rental is still negative, the top priority for Hangzhou government is to identify whether the internet bike system has the value to be implemented into the urban transportation system or if its dockless design could only be a problem to the urban management. More specifically, how many bikes are really needed in Hangzhou and in what way should the internet bike system being operated (on campus, in the scenic area or in the whole city) need to be clearly identified. Based on the estimated demand of the internet bikes, it is recommended that the government could give each company a certain allowance on the number of bikes it could operate and force the company to clean out the surplus bikes. Since it is doubtful that whether the wide-scale implementation of the internet bike system is the right move, it is recommended that the government should let the internet bike system firstly operated on a relatively small scale. The campus is an ideal environment for operating the internet bike rental. Besides, because Hangzhou is rich in tourism resources, operating in the scenic area can also be a good example since these areas are also equipped with relatively well-developed bike path (Yu et al, 2009).

It is noticeable that the willingness of the internet bike companies to comply with the government's requirements is rather negative. This is mainly because the government hasn't implemented any strict regulations to regulate the internet bike companies. Thus, if the internet bike system is considered as socially desirable in terms of the social and environmental sustainability, more regulations with legally binding force are needed to ensure the cooperation of the companies. More specially, the regulation should aim to stimulate the fair and healthy competition between the internet bike companies. For example, the government should guide the competition from "more bikes" to "better management". Except limiting the number of bikes, the government could conduct regular evaluations on the performance of each bike companies such as on the bike parking management, bike maintenance and deposit return.

Although the Hangzhou citizens have been involved in the internet bike rental niche, their opinions still remain scattered and should be managed in a more efficient way. It is also important to enhance the communication between the users and the companies to ensure the companies could learn the difficulties the users encountered. In this case, the main obstacle is the lack of the incentives from the user side. It is recommended that the internet bike companies could give some rewards to promote the users to report the bike malfunction. Moreover, it is recommended that Hangzhou government could establish a specific platform to stimulate the citizens to share their opinions about the internet bike rental.

To improve the knowledge creation and transfer, several suggestions are given on the different learning aspects. **Firstly**, the experiments on the application of the parking technologies, such as the electric fence and monitoring platform, need to be better managed to test the effectiveness of these methods. It is suggested that a stricter reward and penalty scheme should be implemented. For instance, the user who didn't park the bike in the designated areas would be charged with a fine and the user who followed the rules would be rewarded with extra credits. It is also suggested that the government should organize performance review meetings on a regular basis to evaluate the performance of these technologies and be open to the opinions of the researchers and citizens. **Secondly**, the research on the environmental impact of the internet bike rental should be carried out by a third party who doesn't have any relationships with the internet bike companies. Besides, it is suggested that the research should reveal the real environmental impact of the internet bike rental on the basis of its current excessive production model. **At last**, since the internet bike companies currently haven't found the right profit model, it is recommended that future research could pay more attention to the economic processes of the internet bike rental and to explore the suitable profit model for the companies.

# 7. Conclusion and discussions

In this chapter, the conclusion is given in section 7.1, which answers all the research questions. The reflections and recommendations on broader relevance, the theories, and this research are given in section 7.2.

## 7.1 Conclusion

The internet bike rental is a newly-emerged bike sharing scheme that has drawn a lot of public attention. The aim of this research is to provide the insights on the development of the internet bike rental and to identify the potential solution that could alleviate the current issues that it encounters. The main research question "In what way did the internet bike system emerge and develop in Hangzhou and how could the issues it currently encounters being solved?" is used to guide this research. To facilitate the analysis in this research, the main research question is divided into five stepwise sub-questions. The main research question could be finally answered by answering sub-questions 4 and 5. Based on the results of the analysis, the answers for each sub-question are presented below.

***1. What is the internet bike rental and how is it operated?***

The internet bike rental is a newly-emerged bike sharing system. The internet bike itself doesn't differ much from the regular bike. The biggest innovation in the bike design is its smart bike lock. With the help of information technologies, users can see a map of all the bikes parked in the vicinity from the app and unlock the bike by directly scanning the QR code using their smartphone. The internet bike system differs from other bike sharing systems as it adopts the dockless design which allows the users to park the bikes everywhere they want. This characteristic of the internet bike rental stimulated the development of the parking technologies. Among all the parking technologies, the electric fence is the most distinguished one. It can be understood as one designated virtual parking area. With the help of GPS and Bluetooth technology. If the user failed to park the bike in this area, the bike would not able to be locked.

Several internet bike companies have emerged in a very short amount of time. However, most of these internet bike companies don't produce the bikes by themselves. They acquire the bikes from traditional bike manufacturers. The bikes are produced in a centralized way and are transported to Hangzhou. The internet bike companies in Hangzhou are mainly in charge of the operation of the system and the maintenance of the bike. For now, these internet bike companies haven't found a way of gaining profit and are mostly relying on the venture capitals to maintain their operation.

***2. What theories could be used to address the research question and how could they be applied in this study?***

In this research, a combination of Strategic Niche Management (SNM) and the Multi-Level

Perspective (MLP) was applied to analyze the development of the internet bike in Hangzhou. These two theories have been frequently applied to demonstrate the breakthrough of innovations and to address the issues of introducing them to the society. SNM is a bottom-up research model with the emphasis on the management of the internal niche processes. MLP could provide additional insights by drawing the attention to the alignment of the niche development with broader developments. By combining these two theories, a more comprehensive image of the development of the internet bike rental in Hangzhou could be derived.

In this study, MLP was applied to analyze the external factors at the regime and landscape level, while SNM was applied to identify the current issues that the internet bike niche encounters. In the end, these two theories were combined to demonstrate the development of the internet bike rental in Hangzhou. The stepwise processes can be described as follows: 1) The identification of the three levels: Identification of what should be the landscape, regime and niche level with regard to the internet bike development. 2) Landscape and regime analysis: Identification of the changes and trends at the landscape level and the factors at the regime level that could block or facilitate the breakthrough of the niche. 3) Niche analysis: analyzing the internet bike rental niche based on the three niche internal processes and their interactions.

***3. What are the external factors that have an influence on the development of the internet bike rental in Hangzhou?***

The external factors are identified at both landscape and regime levels. The regime is identified as Hangzhou mobility. The landscape refers to the external environment over Hangzhou mobility regime. Overall speaking, most of the external factors are considered to be positive to the development of the internet bike rental.

At the landscape level, the contextual environment of the internet bike rental in Hangzhou is considered to be positive. A number of landscape factors are considered to be favorable to the development of the internet bike, such as the supportive national policy and the needs for new economic momentum. The prevalence of mobile payment across China laid a solid foundation and directly facilitated the emergence of the internet bike. The environmental concerns would push the government to take more actions to stimulate the development of public transport, which might destabilize the automobile regime.

At the regime level, It is believed that the current Hangzhou mobility regime in Hangzhou is dominated by the automobile. The high and stable user demand and well-developed automobile industry contribute to the stability of the automobile regime in Hangzhou. However, there is one "crack" in Hangzhou automobile regime which is the serious traffic congestion. This provides the opportunity for the development of public transport. More importantly, the solid support from Hangzhou government is considered to clear the obstacles in the way of constructing public transport system. The promising future of the public transport is considered to be favorable to the development of internet bike rental. Since the internet bike rental aims to connect with major urban transit to solve the last mile problem, a well-established public transport system could definitely facilitate the development of the internet bike system. Plus the relatively

well-developed urban slow traffic system, it is believed that the future Hangzhou mobility regime is considered to be favorable for implementing the internet bike system.

***4. Who are the stakeholders involved in the internet bike rental and how did these stakeholders foster the development of the internet bike rental?***

The development of the internet bike rental in Hangzhou could be distinguished into three phases. In the first two phases, the internet bike companies and the users are the only stakeholders in the internet bike rental niche. The expectation of the future development of the internet bike rental was high and positive. However, when the internet bike began to cause a series of problems to the traffic system, the expectation was subtly changed. More stakeholders began to be involved, including the media, researchers and Hangzhou government.

During the first phase of the development of the internet bike rental in Hangzhou, the bikes were operated in a protected area, which hadn't formed any interaction with Hangzhou mobility regime. The company's expectation of stimulating bike sharing on the campus wasn't shared by the students. Although the company's expectation is specific, it didn't promote the sufficient learning from their side. The learning was still pretty much on the level of "maintain the current situation" without seeking for further improvement. It is believed the predominant reason for insufficient learning is due to the fact that ofo had later changed their focus from the campus to the whole city. The change of their business strategy weakened the robustness of this expectation.

In the second phase, several rounds of financing paved the way for internet bike system to be operated on a larger scale. Driven by the high expectation of the market potential, a number of internet bike companies started to launch their system in Hangzhou city. That's when the internet bike rental initially entered the Hangzhou mobility regime. The "wait and see" attitude of Hangzhou government didn't form any barriers for the companies entering Hangzhou. This is because cycling is considered as an environmentally friendly travel method. It complies with the aim of stimulating the development of public transport in Hangzhou. Back to that time, the internet bike hadn't caused serious problems. It is believed that the internet bike companies and the users were the main stakeholders. The bike company brought up the vision that the internet bike system could corporate with the public bike system to solve the last mile problem. However, most of the researchers and Hangzhou citizens are skeptical about this expectation (Wo men yuan zhuo hui, 2016). It is evident that this vision is only used by the internet bike company for the purpose of commercial publicity.

The third phase began when the internet bike system started causing serious traffic problems. More stakeholders began to involved in the internet bike rental niche, of which the involvement of the government largely affected the future direction of the development of internet bike rental. Because of it was the time when Hangzhou NPC & CPPCC meeting was held, several members of Hangzhou committee of the CPPCC joined the discussion of how to manage the internet bike system. The stakeholder's expectation began to turn to negative about the current development of the internet bike rental because of these problems, but they still believed that the internet bike system could provide positive social and environmental impact in the future if it is

well-managed. Based on this expectation, the researchers started to learn about how to regulate the development of internet bike from several aspects, such as the illegal parking, deposit management, etc. Hangzhou government had published two regulations on the internet bike rental which they learned from researchers, the experience from other cities and the attitude from the national government. However, It is believed that the attitude from the national government has the most predominant influence on the local policy drafting, as the "Guiding Opinions" issued by Hangzhou government has a lot of similarity with the "Guiding Opinions" published by the national government.

It has already shown that the adoption of the internet bike rental could also reversely affected the current Hangzhou mobility regime. Due to the emergence of the internet bike. the government started to assign more places for bike parking not only for the internet bikes but also for all the non-motor vehicles. To conclude, it is evident that Hangzhou government will dominate the future development of the internet bike rental.

***5. What issues does the current internet bike rental encounter and how could these issues be solved?***

The development of the internet bike system in Hangzhou is still in the initial phase. There are several issues related to its current development. **Firstly**, the current development of the internet bike rental still pretty much relies on the venture capitals from the investors, which has a lot of uncertainties. Because of failing to attract more investments, some bike companies went bankrupt and don't have the money to refund the user's deposit. **Secondly**, although Hangzhou citizens have been involved in the internet bike niche, their opinions are not well articulated. Their communications with the companies are limited. **Thirdly**, most stakeholders still believe in that the internet bike has the potential to be largely implemented and bring positive social and environmental impact. However, this expectation is considered to be a little blindly optimistic. **Fourthly**, the lessons on the environmental contribution of the internet bike rental are not convincing. **Last but not the least**, although there are fruitful lessons on the policy aspect, the companies' behaviors are still questionable since the published regulations don't have the legally binding force. Due to this reason, the interaction between the companies and the government didn't promote much progress because of the companies don't feel the obligation to comply with the government's requirement, such as the requirement to stop releasing more bikes.

Based on these findings, several suggestions are made. **Firstly,** it is important for the government to identify the potential risks of the internet bike rental rather than blindly encouraging its development. More specifically, how many bikes are really needed in Hangzhou and in what way should the internet bike system being operated need to be clearly identified. **Secondly**, to facilitate the participation of Hangzhou citizens, it is recommended that the government could establish a specific platform to stimulate the citizens to share their opinions about the internet bike rental. Besides, it is suggested that the government and the companies could implement a reward and penalty scheme to regulate the users' behavior. **Thirdly**, it is suggested that the research on the environmental contribution of the internet bike rental should be conducted by a third party and should reveal the real environmental impact of the internet bike rental on the basis of its current excessive production model. **At last**, it is recommended that more regulations

with legally binding force are needed to ensure the cooperation from the companies side.

## 7.2 Reflections and recommendations

### 7.2.1 Broader relevance

Since most of the current first and second-tier cities are encountering the similar problems (bike parking issues, deposit safety issues, too many bikes) (Bigdata-Research, 2017), all the suggestions from this research are considered to have the potential to be applied in other cities. The top priority for the government of these cities is to identify in what way the internet bike system could be implemented. The development of internet bike rental in different cities is not completely the same. The population, climate, economic development and topography of the city can all affect the potential of developing the internet bike rental. The governments in different cities should take all these factors into consideration when regulating the internet bike system in their cities. Such as the real demand for the internet bikes should base on the population and the economic development of the city.

It is found in this study that the attitude of the national government has a great influence on the local government's actions. In the case of the internet bike rental, the favorable attitude from the national government does provide an opportunity for the development of the internet bike system. However, it is advised for the national government to identify the potential risks of the internet bike rental and regulate the behavior of the bike companies to stimulate fair competition and a healthy development of the internet bike rental. The national government should take the lead to stimulate the local government to publish stricter regulations.

At last, it is recommended that the national media could be the monitor of the internet bike rental niches in different cities. By circulating and disseminating the experience and information in different cities, the national media could contribute to the overall development of the internet bike rental. For example, if the internet bike rental has encountered new problems in some cities, the national media could expose these problems and give other cities more time to take precautions.

### 7.2.2 Theoretical framework

Overall speaking, it is reasonable to draw the conclusion that SNM combined with MLP could be applied as a useful tool to demonstrate the development of internet bike rental and identify its current issues. This framework did serve as an effective method to demonstrate the interaction and on-going processes within the socio-technical embedding of the internet bike rental. However, there are still some limitations about this framework that are encountered in the analysis.

Firstly, in the network analysis, the alignment of the network refers to the quality of interactions between stakeholders. The alignment is good if the stakeholders have established a close relationship. But how to evaluate the relationships and the interactions between the stakeholders remains a problem. Raven (2005) argues that the alignment of the network can refer to the degree which the actors' expectations and strategies go in the same direction. However, in that way, it seems like the network alignment is similar to the robustness of the expectation that means the number of stakeholders who share the same expectation. Thus, it is recommended to only select one of these two indicators to avoid overlapping in the niche analysis.

Secondly, it is found that "sharing an expectation" could be rather difficult to realize. In this study, it is argued that most expectations are created or influenced by the government because they have the highest power. For example, the expectation about alleviating the parking issues by the application of the information technologies is mostly shared within the government entities but not with other stakeholders. The researchers and users have pointed out the potential drawbacks of these technologies and are doubtful about the real effect of them. However, it didn't affect the subsequent implementation of these technologies. That is to say, it is not the shared expectation that promotes new learning. Unless the stakeholder who held the expectation has the dominant resources and power, this expectation could also promote the niche development in a certain direction. Thus, it is recommended that the analysis of the niche expectation could be combined with the power-interest analysis of the stakeholders to provide insights about the future development of the niche.

Thirdly, it is found in this study that the five aspects of learning process have shown some overlapping. There is one overlapping between the policy aspect and other aspects. For example, in this study, learning about the parking issue of the internet bike rental should be assigned to social and environmental aspect because it has already become a social problem. But it's also related to the policy aspect because the lesson is that the government should publish strict regulation to stop the companies releasing more bikes. The reason for the overlapping is that the policy aspect is rather broad. It could include the policy over different aspects, such as quality standards (technical aspect) and operation permit (industrial development aspect). Thus, it is recommended that the policy aspect of learning could be integrated into other aspects of learning to avoid overlapping.

## 7.2.3 Research methodology

### Analytical framework

Due to most of the current issues are happened within the niche, the suggestions are all aimed at solving these niche problems. Although the landscape and regime are considered to be positive to the internet bike rental, they are still some factors that could limit the development of the

internet bike rental. For example, the priority of developing public transport is given to the metro and bus which have high carrying capacities. It is considered that this factor could limit the wide-scale implementation of the internet bike rental in Hangzhou. It is recommended that if the niche problems would be solved in the future, the limitations at the regime and landscape level should be elaborated, which their influence should be better identified.

In the landscape analysis, the current air pollution and environmental concerns are considered to be positive to the development of the internet bike rental. However, in real life, it is believed that the air pollution issue is a double-edged sword. On one hand, this negative externality will continue to push the national and Hangzhou government to take more actions to tackle this issue, such as promoting low carbon traveling and public transport. On the other hand, bad air quality might also dampen people's enthusiasm for cycling. The actual influence of this factor needs further elaboration. Besides, the landscape analysis in this study focused too much on the landscape influence on the niche instead of on the regime. It is recommended that there should be more analysis on the landscape and regime interaction, which focus on how landscape stabilizes and destabilizes the regime, and how regime reversely affect the landscape (Geels, 2011).

In the regime analysis, the Hangzhou mobility regime is analyzed mostly on the basis of the tangible "system" rather than the intangible "regime". As aforementioned, regime refers to the alignment of the rules that are centered around one or several technical artifacts. According to Geels (2011), a regime is more like an underlying structure that guides or influence the activities of the actors who produce system elements. For example, a regime could include the rules of thumb, the social norms and the routines of doing things. It is different from the concept of "system" which refers to more measurable elements such as technologies, regulations, and the market share (Geels, 2011). In this study, the reason to adopt the "system" perspective is that it could provide a more understandable picture of Hangzhou mobility. However, it is recommended that more attention should be paid to the underlying structure that supports the socio-technical system. Besides, the future regime analysis could include multiple regimes. For example, another regime related to the internet bike rental is the financial regime. Since the current internet bike rental pretty much relies on the venture capitals, the analysis of the stability of financial regime could help identifying the uncertainties related to the financing of the internet bike companies.

At last, the influence of the public bike system is not clearly identified in this research. That's because the public bike company currently hasn't formed any relationships with the internet bike companies. Their influence could not be identified using the SNM framework. To give an overview, the influence of public bike system is briefly discussed here. Hangzhou has the most well-established public bike system in China. The public bike system has existed long before the internet bike and has built a good image among the Hangzhou citizens. According to Hangzhou Daily (2017), 84.66% Hangzhou citizens are satisfied with the operation of the public bike system in 2017. Due to the standardized management and good maintenance of the bike, the public bike company has the stable market shares among the long-term Hangzhou residents (interview with public bike company, 2017, see quote 5, Appendix C). Besides, the public bike system is designed as a welfare service. In 2017, more than 96% trips made by the public bike is free of charge

(Hangzhou Daily, 2017). The rental price of the public bike is even lower compared to the current internet bike. These two factors are considered to limit the development of internet bike rental in Hangzhou. It is considered that for the city without public bike system, the government might have a more favorable attitude towards the internet bike system.

## Data collection

In this study, not all the main stakeholders are sufficiently covered. The analysis was limited to the interaction between the government, the companies and the researchers and might not provide a clear picture of the development of the internet bike rental in Hangzhou. The results showed that the development of the internet bike rental has been dominated by the Hangzhou government. But in the real case, the situation may differ since the investors also have high power and their behaviors aren't controlled by the local government. Thus, it is recommended to include the other stakeholders (the investors and the bike manufacturers) in the future research.

For the stakeholders did get covered in this study, there are several limitations about collecting the data from them. Some barriers were encountered during the conduction of the interviews, which limited the amount of the useful information. The information about the initial phase of the development of the internet bike rental was not sufficiently collected. It might cause an incomplete overall picture of the internet biking development in Hangzhou. Besides, there are several limitations on the conduction of the user interviews. Firstly, in some of the user interviews, the user didn't follow the interview questions, their answers are rather simple and did not provide sufficient information, especially on their expectations about the internet bike rental. Secondly, because the users of the internet bike rental are many, the qualitative research method (interviews) has shown the inability to collect enough information. For improvement, quantitative research method could be combined with qualitative research method to include more users in the future research, such as a short survey with additional open questions.

Another limitation is related to the data quality of this research. Because the interview didn't provide as much as useful information. Several online resources were applied in the niche analysis. Some of these resources are the reports published by some consultancy companies and the internet bike companies. It has been observed that the data from these reports might not be very accurate. In this research, these data (such as the environmental contribution of Mobike's internet bike system) were analyzed in a critical way. It is recommended that more in-depth interviews are needed to provide sufficient data to avoid this issue.

At last, since the internet bike rental is still in the initial stage, the situation of its development is constantly changing. Lots of uncertainties might change the direction of its development in the future. It is recommended more research need to keep up with to provide updated information in the future.

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# Appendix A. The power-interest analysis

The power of the stakeholders is analyzed based on their interests and objectives. The internet bike companies as the initiator of the internet bike scheme, are considered to have the highest interest. So are the investors and bike manufacturers since they are highly involved in this business. Three government entities share a high interest because the disorder of the internet bike system has caused serious problems and endangered the stability of Hangzhou society. The public bike company also has the high interest due to the internet bike companies are their biggest competitors. It is said that the emergence of the internet bike has caused a 10.34 % reduction in public bike use (Yu and Ren, 2017). The researchers, logistic companies, users, and the local media are considered to have a medium interest. Among them, the researchers have the highest interest due to the internet bike rental is a hot issue and is relevant to their specialty. The logistics companies also have a relatively high interest because it is a good business opportunity for them. As for the local media, although they have paid a lot of attention to the internet bike, it is believed that their attention could be easily attracted by other more urgent issues. The non-users are considered to have the lowest interest because they are not related to the internet bike rental in any means, but they might still have some interest due to the fact that the internet bike rental also affects their daily life.

| Actors | Interest | Objective | Conclusion |
|---|---|---|---|
| The internet bike companies | To make the internet bike integrated into the urban public transport | Increasing market share, gaining profit | The Highest |
| The investors | Return on capitals, more market shares | Profits | High |
| Bike manufacturers | Long-term cooperation with the internet bike companies | Profits | High |
| Hangzhou Transportation Bureau | Better management of the internet bike | To facilitate the overall coordination of the management system | High |
| Hangzhou Municipal Commission of City Administration | Better management of the internet bike | The internet bike would cause less parking issues (on the footpath) | High |
| Hangzhou Municipal Bureau of Public Security | Better management of the internet bike | The internet bike would cause less parking issues (on the road) | High |
| The public bike company | Co-exist with the internet bike | How to win the customers back from the internet bike companies | High |
| The researchers and institutes | A more standardized development of the | Solve the current issues and prevent future risk | Relatively high |

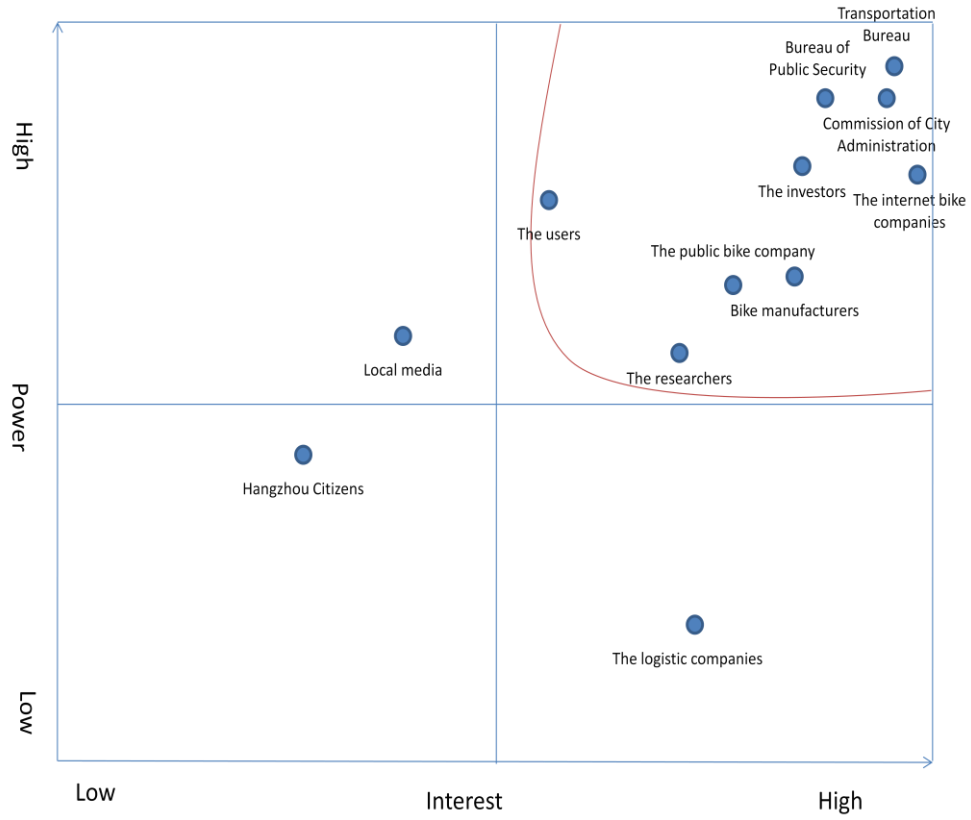
| | | | |
|---|---|---|---|
| | internet bike | | |
| The users | A better service provided by the internet bike | Better user experience | Medium |
| Hangzhou citizens (non-user) | A more standardized development of the internet bike | Less negative social impact | Relatively Low |
| Local media | A more standardized development of the internet bike | Stimulate the problem being solved | Medium |
| The logistics company | Long-term cooperation | Gaining profits | Relatively high |

The power of the stakeholders is analyzed based on the important resource the stakeholders have, replaceable or not, and the dependency of the resources. The government entities are considered to have the highest power over the management of the internet bike development. The investors also have a dominant power since they provide internet bike companies with sufficient financial resources. The internet bike companies surely have the high power. But their power is considered to be lower than that of the government. The public bike companies, as the only competitor, also have the power to exert a certain influence on the internet bike development. The bike manufacturers are considered to have high power because they are hardly replaceable. The researchers, non-users, and local media are all considered to have a medium power because their participation could put pressures on the government to take more actions. At last, it is believed that the logistic companies have the lowest power and is replaceable.

| Actor | Important resource | Replaceable? | Dependency? | Conclusion |
|---|---|---|---|---|
| The internet bike companies | They got most of the resources to make the system work | Not replaceable | Completely dependent | High power |
| The investors | Financial resource | Not replaceable | Completely dependent | High power |
| Bike manufacturers | Supply of bikes | Not replaceable | Highly dependent | High power |
| Hangzhou Transportation Bureau | Regulations, guideline and other forms of law | Not replaceable | Completely dependent | Highest power |
| Hangzhou Municipal Commission of City Administration | The power to supervise and regulate the implementation of the regulations | Not replaceable | Completely dependent | Highest power |
| Hangzhou Municipal Bureau | The power to supervise and regulate the | Not replaceable | Completely dependent | Highest power |

| | | | | |
|---|---|---|---|---|
| of Public Security | implementation of the regulations | | | |
| The public bike company | The land and user resources | Not replaceable | Highly dependent | High power |
| The researchers and institutes | The ability to affect the government's actions | Yes | Dependent | Medium power |
| The users | The determinant of the success of the business | Not replaceable | Completely dependent | High power |
| Hangzhou citizens (non-user) | The ability to affect the government's actions | Yes | Dependent | Medium power |
| Local media | The ability to let the problem being seen | Yes | Dependent | Medium power |
| The logistics company | The resources for the transportation of the bikes | Yes | Independent | Low power |

Based on the aforementioned results, the power vs. interest grid can be mapped as follows. The three government entities, internet bike companies, the public bike company, the researchers and the users are the "key players" in the internet bike rental niche. They become the target groups of the interviews. The investors and bike manufacturers are excluded since it is difficult to contact them.



# Appendix B. Interview protocols

## Expert interview protocol

Date:
Institutions:
Name of the interviewee:

**The introduction**

1. An Introduction to myself and this research.

I'm a master student in Industrial Ecology from TU Delft. I'm currently in the process of my graduation thesis research. The research is aiming to analyze the development of the internet bike rental in China by applying strategic niche management (SNM) and the multi-level perspective (MLP). Besides, this research also aims to identify the potential problems with regard to the current development of the internet bike rental in China and to explore the possible solutions to guide the future development. (An explanation of what SNM and MLP are for is needed for the interviewees who don't have the background in the relevant field).

2. Explaining the objective of this interview, review of interview method, use of data and confidentiality.

The objective of interviews is to obtain information and gather perspectives from different types of stakeholders. All the data is only for the purpose of this thesis research. All the interviews are intended to be recorded but with the permission of the interviewee.

3. Inquiry of the background of the interviewee.

First, let the interviewees give a brief introduction of themselves. According to the information the interviewees provide, Some general questions will be asked in the form of an open dialogue. However, the open questions session is subject to change and could be skipped if there is not much time left.

**Interview questions**

1. Could you please explain how is your organization's function relevant to the internet bike rental? What are your responsibilities?

2. Could you please introduce the current development and achievements of the internet rental bike in Hangzhou?

3. What do you know about the actors that take part in the development of the internet rental bike? What are their relationships with you and with the others?

Based on the following aspects:

- The bike design and any other technologies that are associated with the bike
- Users' characteristic and preference

- The social, environmental impact induced by the emergence of the internet rental bike
- Relevant legislation
- Maintenance and the supply chain

4. What have you learned about these aspects? What do you think they should be developed in the future? Why?

5. According to your expectation, what would you do to improve these aspects?

# User interview Protocol

Date:
Institutions:
Name of the interviewee:

**The introduction**

1. An Introduction to myself and this research.

I'm a master student in Industrial Ecology from TU Delft. I'm currently in the process of my graduation thesis research. The research is aiming to analyze the development of the internet bike rental in China by applying strategic niche management (SNM) and the multi-level perspective (MLP). Besides, this research also aims to identify the potential problems with regard to the current development of the bike-sharing program in China and to explore the possible solutions to guide the future development. (An explanation of what SNM and MLP are for is needed for the interviewees who don't have the background in the relevant field).

2. Explaining the objective of this interview, review of interview method, use of data and confidentiality.

The objective of interviews is to obtain information and gather perspectives from different types of stakeholders. All the data is only for the purpose of this thesis research. All the interviews are intended to be recorded but with the permission of the interviewee.

3. Inquiry of the background of the interviewee.

First, let the interviewees give a brief introduction of themselves. According to the information the interviewees provide, Some general questions will be asked in the form of an open dialogue. However, the open questions session is subject to change and could be skipped if there is not much time left.

**Interview questions**

1. Could you please introduce your age and occupation?

2. Could you list any main problems that you think the current Hangzhou transportation system encounters? (For example: traffic congestion, the time or money cost etc.)

3. What do you think about the internet rental bike? Have you used it before? Do you like it?

Based on the following aspects:

- The bike design and any other technologies that are associated with the bike
- Users' characteristics and preference
- The social, environmental impact induced by the emergence of the internet rental bike
- Relevant legislation
- Maintenance and the supply chain

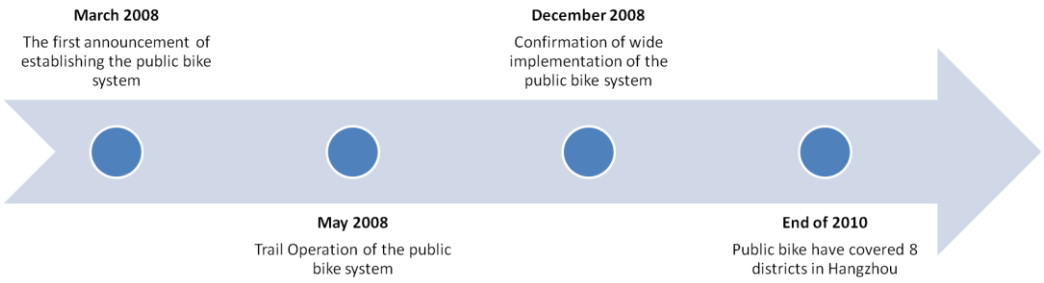
4. What have you learned about these aspects? What do you think they should be developed in the future? Why?

# Appendix C. Quotes from the Interviews

| Quotes from the interviews | Interviewee types |
|---|---|
| 1. "The bike parking was well managed by the operational staff back then" | User type A |
| 2. "We have established a Wechat group. when there are some places encountering the problem, our people would send a notification to this group." | Government entity B |
| 3. "Mobike, ofo and Haluo bike are taking turns to manage the parking. Each company is responsible for 10 days for every month. They are responsible for not only their bikes, but all the bikes" | Government entity B |
| 4. " I normally don't report the bike malfunction, I might just look for another one... and I fell like the broken bikes are more and more common to see." | User type A, B and C |
| 5. "We believe we have a stable demand from our customers, who are mostly the long term Hangzhou residents." | Public bike company |
| 6. "There are normally 2 to 3 phone call from the citizens complaining about the parking of the internet bikes, the highest record is more than ten phone calls a day. All these complaints were put in priority and solved first." | Government entity B |
| 7. " I believe there is no potential to develop the internet bike system ....I think the internet bike companies in the future will be merged by the government" | Researcher A |
| 8. " We hope to see one or two internet bike companies would operate in the future , so we could managed them together with the public bike company" | Government entity A |
| 9. " There will be more regulations and methods to regulate the internet bike system on the aspects of bike quality, company operation and bike registration.....but it is not wise to do it now since there are still uncertainties in the market." | Government entity A |
| 10. " I think the current bike design is already good. I mean, it is just a bike.....but there are also some problems . The major one is the high broken rate of the bikes...." | User type A |
| 11. " The users are unfamiliar with the bike condition, which might be a risk.... Besides, it should be clear that who should be responsible for the accidents caused by the use of the internet bike." | Researcher B |

# Appendix D. Bike sharing history in Hangzhou

Bike sharing in Hangzhou started in 2008, which the first bike sharing system was initiated by Hangzhou government (Sun, 2015). Until now, different kinds of internet bikes operated by different private companies coexist with the public bike system run by the government. Generally, the history of bike sharing in Hangzhou can be distinguished into two major phases: the dominance of the public bike (2008-2016), and the explosion of the internet bike (2016 to present). The history before the emergence of internet bike system in Hangzhou is illustrated in the figure below.




The history of public bike system in Hangzhou (created by author)

According to Sun (2015), before the emergence of public bike program, there were no wide applications of the bike-sharing system in Hangzhou. For Hangzhou citizens, the only option left was to own a bike by themselves. For tourists, there were several bike rental service points but only operated around the West Lake area. This situation was totally changed when the Wang Guoping, who was the secretary of Hangzhou municipal committee of the Communist Party of China, firstly proposed the idea of constructing an urban bike sharing system in Hangzhou. The successful implementation of bike sharing systems in the foreign cities (Paris, Lyon, and London) boosted the confidence of Hangzhou government to establish their own system. Hangzhou government realized that the blind development of the private vehicles cannot be the solution to the city's traffic problems. The bike should play an important role in the overall urban public transport system. (Sun, 2015)

On March 3rd, 2008, Hangzhou Municipal committee and Hangzhou government officially announced the construction of Hangzhou public bike system. The government set the date of trial operation of May 1st and the official operation date of September 16th. In the trial operation, 2800 bikes were released to the West Lake scenic area and the northern and the southern part of Hangzhou. Besides, Hangzhou government also started the construction of 61 bike service points, which was conducted by five branch companies affiliated to Hangzhou Public

Transport Group Co., Ltd. The operating time was initially set as 6:30 to 20:00 but later changed to 6:00 to 21:00. All the bikes were produced by Tianjin Flying Pigeon bike manufacturing Co., Ltd. (Sun, 2015)

The trail operation turned out to be a great success. Until December 15th, 2008, Hangzhou public bike system had been expanded to a system with 280 service points and in total 8100 bikes. On December 19th, after half year's operation, Hangzhou public transport group Co., Ltd held a review meeting to evaluate the performance of the public bike system, gathering the experts from Zhejiang University, Hangzhou Dianzi University, Zhejiang University of Technology, Science Technology Department of Zhejiang Province, etc. In this meeting, most of the experts believed the public bike system had shown its positive contribution to Hangzhou public transport, which they suggested it should be widely implemented in all the other area of Hangzhou. That's when Hangzhou public bike started its surging growth. (Sun, 2015)

From that moment on, the public bike gradually made its way to the remaining districts of Hangzhou. In February 2010, the public bike first entered the Binjiang district (Sun, 2015). Until June of 2010, there were in total 2000 service points which had the capacity to provide 43300 parking spots (Shi et al, 2011). At the end of 2010, the system had cover 8 districts in Hangzhou with 2411 serving points and 60.6 thousand bikes. Until 2013, the overall rental amount of the public bike had exceeded 100 million (Sun, 2015). The details of the development of the public bike in Hangzhou is shown in the table below.

| Districts | Population (million) | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Service points | Number of bikes | Service points | Number of bikes | Service points | Number of bikes | Service points | Number of bikes | Service points | Number of bikes | Service points | Number of bikes | Service points | Number of bikes |
| Main urban area | 327.14 | 343 | 4900 | 1970 | 49400 | 2200 | 51500 | 2207 | 51500 | 2249 | 51500 | 2281 | 51500 | 2330 | 54600 |
| Binjiang | 31.9 | | | 300 | 600 | 96 | 3500 | 153 | 3500 | 211 | 4000 | 223 | 5000 | 227 | 5000 |
| Xiasha | 31.07 | | | | | 41 | 1800 | 100 | 1800 | 151 | 4000 | 157 | 5000 | 168 | 5000 |
| Xiaoshan | 151.13 | | | | | 20 | 1000 | 99 | 1000 | 190 | 5250 | 190 | 8500 | 190 | 8500 |
| Yuhang | 117.03 | | | | | 54 | 1800 | 115 | 1800 | 161 | 5000 | 216 | 8000 | 216 | 8000 |
| Linan | 56.67 | | | | | | | | | | | | | | |
| Fuyang | 71.77 | | | | | | | | | | | | | | |
| Tonglu | 40.64 | | | | | | | | | | | | | | |
| Chuanan | 33.68 | | | | | | | | | | | | | | |
| Jiande | 43.08 | | | | | | | | | | | | | | |
| In total | 904.11 | 343 | 4900 | 2270 | 50000 | 2411 | 59600 | 2674 | 59600 | 2962 | 69750 | 3067 | 78000 | 3131 | 81100 |

Development of public bike in Hangzhou (adapted from Sun, 2015)