BPLN0039_VNZK0

by Tiankuang Xu

Submission date: 05-Sep-2022 02:03PM (UTC+0100)
Submission ID: 185689233
File name: BPLN0039_VNZK0_3828312_165715261.pdf (1.28M)
Word count: 18505
Character count: 104057

LONDON'S GLOBAL UNIVERSITY

University College London

Faculty of the Built Environment

The Bartlett School of Planning

Investigating users' perspectives on bike-sharing in Jinan, a second-tier city in China

VNZK0

Date:05/09/2022

	Word count
Main body of dissertation	9985
Appendices	3260

Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of MSc Transport and City Planning at University College London:

I declare that this dissertation is entirely my own work and that ideas, data, and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

Acknowledgement

First, I would like to express my heartfelt gratitude to my supervisor, Dr. Mengqiu Cao. When I was initially confused about the direction of my dissertation, he was very patient and provided me with advice and inspiration from many angles. My supervisor is very approachable, academically rigorous and professionally experienced. His guidance and out-of-the-box thinking have been a source of inspiration to me. Dr. Mengqiu Cao is not only a role model for me in academics, but also in his enthusiasm for life, his seriousness and responsibility for his work, and his positive attitude towards life are worth learning. Again, I would like to express my sincere gratitude and highest respect to my supervisor, Dr. Mengqiu Cao.

I would also like to thank Professor Robin Hickman, Dr. Jonas De Vos and Dr. Iqbal Hamiduddin, who not only enhanced my understanding of the academic subject but also helped me to develop the habit of critical thinking in my academic studies and in my life. I would like to express my special thanks to Professor Robin Hickman who provided me with valuable guidance and advice on how to broaden my horizons while trying to improve myself academically and experience life abroad.

In addition, I would like to thank the respondents who helped me selflessly during the research process and who provided me with data that enabled me to complete the study successfully. Finally, I would like to express my heartfelt gratitude to my parents and friends for their support in allowing me to progress in my study and in life.

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Abstract

High dependence on vehicles poses a huge challenge to sustainable transport development. Bike sharing schemes are seen as an effective way to tackle problems of traffic congestion and environmental pollution caused by the rapid increase of the use of motor vehicles, especially in China, a country which now has a high level of car ownership. However, current perspectives on bike sharing programmes among users in second-tier and third-tier cities in China remain ambiguous, which has led to an inadequate data pool on bike sharing. This dissertation therefore aims to investigate users' perspectives on the development of bike sharing programmes using Jinan, a second-tier city in China, as an example. A qualitative research method was used to conduct semi-structured interviews with 25 users about their perceptions of the development of the bike sharing project in Jinan. Research has shown that the main driving factors that promote shared bicycle use are convenience, time-saving and financial savings. The primary deterrents to the use of shared bicycles, meanwhile, are attributed to vandalism, unregulated use and uneven distribution of bicycles. These findings imply that China could learn from Western countries to achieve sustainable development of bike sharing programmes by improving bike sharing related infrastructure, putting bike sharing users first and strengthening government policy interventions. In addition, the findings suggest that a three-way partnership between government, operators and users, with clear responsibilities, could be the best option for achieving sustainable bike sharing. Finally, the findings suggest that credit mechanisms for bicycle sharing use, the introduction of new technology for bicycle sharing and policies and activities that facilitate promoting bicycle sharing should be prioritised by policymakers and bike-sharing operators.

Keywords

Traffic congestion; Sustainable transport development; Bike sharing; Transport policy; Jinan

1. Introduction

1.1 Background

The traffic congestion and environmental pollution caused by the rapid proliferation of motor vehicle use are huge challenges for society today (Li and Kamargianni, 2018). Over the past two decades, bike sharing has become increasingly popular around the world as a sustainable way of travelling (Shaheen et al., 2010). Bike sharing programmes are regarded as having great potential to address a range of issues such as environmental pollution, traffic congestion, increased carbon emissions and noise pollution caused by the increased use of motor vehicles (Sælensminde, 2004; Shaheen et al., 2012a). Further benefits of bike sharing that have been identified include reduced risk of various diseases on the part of bike users, savings of money and time and increased connectivity between public transport hubs (Andersen et al., 2000; Jäppinen et al., 2013; Shephard, 2008). For instance, when shared bicycles are used for short trips, there are time and cost savings advantages (Wang et al., 2019). Meanwhile, bike sharing is considered an important means of solving the first and last mile problem (Wang et al., 2019). Shaheen et al. (2010) explored how bike sharing programmes offer short-term bike hire from docking stations to destinations, allowing users the flexibility to rent shared bicycles on demand while not taking on ownership of a bicycle.

Currently, bike sharing programmes are considered an important component of sustainable urban transport strategies in Europe, the Americas and many developing countries (DeMaio, 2009; Li and Kamargianni, 2018; Lyu et al., 2021; Shaheen et al., 2010; Yang et al., 2010). For China, a country with a high rate of private car use, bike sharing is also considered to have great potential to address the many negative impacts faced by the over-reliance on vehicles as the primary mode of urban transport (Zhang et al., 2015).

The period from 1950 to 1970 can be regarded as the beginning of bicycle popularity in China. Although the use of bicycles was relatively low at that time, bikes were gradually integrated into people's lives as a means of transportation (Zhang et al., 2015). In 1980, China was acknowledged as the ‘kingdom of the bicycle’ thanks to the repaid growth of bicycle use (Wang et al., 2019; Zhang et al., 2015). However, the year 1990 marked a significant turning point in the development of cycling in China, as the use of bicycles declined significantly due

to the rapid growth in the number of private motor vehicles from then onwards (Li et al., 2017; Yang, 2006).

In the context of a series of ensuing negative impacts such as road congestion and pollution emissions, the Chinese government subsequently introduced its bike sharing programme. The programme was first introduced in 2007 as station-based bike sharing, which was directly managed by the government and subsidised by the bicycle companies. Another form of bike sharing, station-less bike sharing, was officially launched in China in 2014 and has quickly taken over the market (Wang et al., 2019). Cyclists only need to register with their smartphones to become bike users. First, they authenticate and connect the bicycle software through their mobile phone payment software, then they pay a deposit and scan the QR code on a bicycle to use it. Wang et al. (2019) point out that smartphone-based bike sharing subscriptions in China are already up to 65% as of 2015 and are continuing to rise. The success and popularity of station-less bike sharing systems in China are underpinned by the ability to unlock and locate bicycles via smartphones, devices which are widely used (Wang et al., 2019). More than 80 million bike sharing users registered in China as of 2017 (Wang et al., 2019).

In terms of comparing China's shared bicycle operations, there are two relatively unsuccessful cases as well as two successful cases worth learning from. First of all, the project in Beijing, the first city in China to carry out a shared bicycle programme, was initially run entirely by private companies. However, the lack of policy support from the government led to difficulties in recovering funds, resulting in a decline in service quality and trouble sustaining operations (Zhang et al., 2015). Meanwhile, the bike sharing programmes in Shanghai and Wuhan have each resulted in inefficient use of shared bikes due to unclear delineation of responsibilities and incompatibility in the operation of the systems (Zhang et al., 2015). In stark contrast, Hangzhou has demonstrated a more successful system of bicycle sharing. The government not only provided start-up capital and subsidised loans but also provided service points and authorised bicycle sharing to recover funds through advertising (Zhang et al., 2015). Clearly, a bike sharing project's operations are directly related to the success or failure of the scheme.

Although bike sharing has attracted the attention of many researchers, there are still gaps in the field that need to be filled. Firstly, research on the operation of bicycle sharing schemes

has mainly taken place in Western countries (Shaheen et al., 2014, 2012a); although many studies on bicycle sharing schemes have been carried out in developing countries such as China, the focus has been on mega-cities such as Beijing and Shanghai or new first-tier cities such as Wuhan and Hangzhou—this is a lopsided selection of subjects (Zhang et al., 2015). In China, which in 2015 already had over a hundred cities with bike sharing schemes, there have been few studies of such schemes in second-tier cities (Wang et al., 2019). Secondly, the main focus of current research has been on using quantitative methods to assess the economic benefits, social contributions and public welfare brought about by bike sharing programmes (Bullock et al., 2017; Otero et al., 2018; Qiu and He, 2018). Such a quantitative approach makes it difficult to examine user perspectives on the development of bike sharing programmes and the factors that promote and discourage cyclists from choosing bike sharing needs (Lyu et al., 2021). Very few studies have adopted a bottom-up approach.

If a bike sharing programme and its related policies are detached from user needs and suggestions, it is challenging to sustain and develop the programme well. As a result, there is a lack of research on the current state of bicycle sharing in second- and third-tier cities and a significant need for qualitative research to better understand the development of bicycle sharing programmes from a user perspective.

1.2 Research Aim and Research Questions

This dissertation aims to investigate the perceptions about the bike sharing programme in Jinan held by its users.

To better understand users' perspectives on the development of bike sharing programmes in Jinan, this dissertation aims to answer three questions:

1) What are the motivating factors for using shared bicycles in Jinan?
2) What are the detrimental factors that hinder user demand for bike sharing?
3) What are users' suggestions for operating and developing a bike sharing programme in Jinan?

1.3 Structure of this Dissertation

This remainder of this dissertation is structured as follows: Section 2 summarises the main current research on bike sharing programmes. Section 3 introduces the case city and the methodology used in the study. Section 4 presents the findings and discussion of the study. Finally, section 5 gives conclusions and recommendations for subsequent research on bike sharing schemes.

2. Literature Review

2.1 The Motivations for Bike Sharing Programmes

Bike sharing is not just an innovative form of active commuting but also an effective application of shared mobility (Hua et al., 2022). Generally, there are two types of bike sharing programmes (Shaheen et al., 2010). The first type is known as station-based bike sharing and uses physical docks, which means that all bike sharing users must pick up and return their bikes at a specific spot where a docking station is located. Some Western cities such as Minnesota, Barcelona, London and Brisbane have implemented station-based bike sharing programmes (Fishman et al., 2013, 2014a). The second type is known as dock-less bike sharing, in which there are no fixed stations and bikes can be located and unlocked directly from a mobile phone with internet (Du and Cheng, 2018; Fishman, 2016). Chen et al. (2020) state that the invention of the dock-less bicycle has dramatically enhanced user experience. Dock-less bike sharing is now widespread in Chinese cities such as Guangzhou, Nanjing and Shanghai.

Fishman (2015) identifies four generations of bike sharing programmes. The first and second generations consist of the white bikes introduced in Amsterdam in 1965 and the coin-deposit bike sharing programme created in Copenhagen in 1995, respectively. However, these first and second generations experienced theft and non-return for prolonged usage, respectively, demonstrating the inadequacy of bike sharing in terms of security (Parkes et al., 2013; Zhang et al., 2014). Subsequently, France developed the third generation of bike sharing programme by incorporating operational user interface technologies to combat non-return and theft (Parkes et al., 2013). Finally, the fourth generation, i.e. the dock-less bike sharing system, is more adaptable and convenient for users due to the incorporation of several high-tech intelligent technologies, such as GPS and smartphones, which have made it possible to cover broader areas and larger scales (Manzi and Saibene, 2018; Pucher et al., 2010; Shaheen et al., 2010).

Numerous studies have proved that the convenience provided by bike sharing is the primary motivation for its popularity (Fishman et al., 2012; Fishman et al., 2013; Shaheen et al., 2011), and that the contribution of bicycle sharing to reducing travel time and costs and improving travel efficiency is an important motivating factor for users (Buehler et al., 2014).

Bike sharing programmes can also be combined with public transport to provide

sustainable transportation in cities. Generally, the point-to-point travel, round trips, and rapid access via docking stations that bike sharing programmes provide promote connections to public transport hubs (Shaheen et al., 2012b). In other words, first-mile and last-mile bike sharing programmes bridge the gap that previously existed for users travelling from their starting point to the station, from the station to the destination and between stations (DeMaio and Gifford, 2004; Pucher et al., 2010). Therefore, the time saved in commuting may be used for additional work and may help to create other economic benefits (Bullock et al., 2017).

Reducing single-occupancy car trips and easing traffic congestion is also considered to be one of the primary motivating factors for implementing bike sharing programmes. Several European and international studies indicate that bike sharing has a positive effect on easing traffic congestion by replacing private car trips (Bachand-Marleau et al., 2012; Fishman et al., 2013, 2014a; Group, 2011).

Another important motivation for bike sharing is its contribution to the improvement of public health and physical activity levels (Ricci, 2015; Woodcock et al., 2014). Oja et al. (1991) found that cycling is recognised as an important contributor to improving population health, as it effectively exercises the whole body's cardiorespiratory and metabolic functions at different intensities (Bassett et al., 2008). Studies have confirmed that health risks such as cardiovascular disease, type-2 diabetes, hypertension and obesity can be reduced and fitness levels can be improved by active commuting (Bize et al., 2007; Wagner et al., 2001). Furthermore, the health benefits of cycling are estimated to be significant and far outweigh the risks associated with traffic accidents and air pollution (Cavill and Watkins, 2007; de Hartog et al., 2010; Pucher et al., 2010). Overall, although it is difficult to quantify the benefits of cycling by comparing the potential increase in life expectancy from cycling to the potential decrease in human life expectancy from traffic accidents and pollution, the health benefits of cycling and its enormous potential for public health cannot be denied.

The environmental contribution of bike sharing programmes is reflected in the reduction of carbon emissions and other pollutants from motorised transport, which improve air quality and promote sustainable development (Ricci, 2015). For example, the Chinese city of Shanghai saved 8,358 tons of gasoline and reduced carbon dioxide and nitrogen oxide emissions by 25,240 tons and 64 tons respectively in 2016 (Zhang and Mi, 2018). Rather than focusing on

the contribution of bike sharing programmes to reducing carbon emissions, however, Fishman (2014a) focused on whether bike sharing programmes reduce the total distance travelled by motor vehicles. The results show that bike sharing programmes effectively reduce motor vehicle use. Still, it is prudent to consider the combined impact of maintaining and transporting shared bikes when implementing bike sharing programmes.

Shaheen et al. (2010) summarise the benefits of bike sharing thus: flexible mobility, emission reductions, physical activity benefits, reduced congestion and fuel use, individual financial savings and support for multimodal transport connections. As a result of these motivational factors, the promotion of bike sharing programmes has also led to a better understanding of the vital role they play in the protection of the environment, the improvement of public health and sustainable development.

2.2 Factors Influencing Demand for Bike Sharing Trips

2.2.1 Weather and Climate Factors

Travellers' preference for bike sharing is largely determined by weather and climate (Eren and Uz, 2020), and temperature's effect on bike sharing is one of the most researched variables (Eren and Uz, 2020). Specifically, trip production is positively correlated with outside temperatures between 0-20 °C; demand for bike sharing reaches its highest level when temperatures are between 20-30 °C (El-Assi et al., 2017). Kim (2018) argues that users' demand for bike sharing in hot weather above 30 °C is negatively correlated with temperature. Furthermore, Wang et al. (2018) investigated the demand for bicycle sharing among different age groups according to weather conditions and state that 12–16 °C temperatures positively correlate with all age groups, whereas 27–32 °C temperatures have a negative correlation.

Cold temperatures might cause more discomfort and have a more negative impact on bike sharing users than hot temperatures (Nankervis, 1999). One Swedish study found a 47% reduction in cycling trips from summer to winter (Bergström and Magnusson, 2003). Generally, rain and snow at cold temperatures are the worst weather conditions for cycling (Gebhart and Noland, 2014; Kim, 2018). Based on the negative correlation between cold weather and demand

for cycling trips, researchers are in complete agreement that cold weather reduces demand for bike sharing (Saneinejad et al., 2012).

Humidity and wind speed have been identified as two other important weather factors affecting the demand for bike sharing (Gallop et al., 2011). Several studies have shown that high humidity and high wind speeds can reduce demand for travel, including but not limited to bicycle sharing (Corcoran et al., 2014; Gebhart and Noland, 2014).

The above research explores weather and climate in terms of temperature, precipitation and snowfall, humidity and wind speed and finds that climate and weather directly affect the demand for bike sharing by influencing the safety and convenience of such travel.

2.2.2 Built Environment and Land Use Factors

To date, numerous researchers have found that built environment and land use components can encourage or discourage bike sharing (Mateo-Babiano et al., 2016). Bicycle Friendly Cities believes that expanding the existing cycle network and putting in new, well-maintained and robust infrastructure will increase the number of people commuting by bike (Schoner and Levinson, 2014). In the case of cycle lanes, for example, lanes which are separated and isolated from the motorway are considered to have a significant and positive impact on promoting the use of bicycles, as they provide a safe and comfortable cycling environment (Habib et al., 2014; Howard and Burns, 2001). Fittingly, a study from Dublin showed that routes without cycling infrastructure or intersecting with motorways were the least attractive to cyclists (Caulfield et al., 2012). Another proven aspect of the built environment's impact on the demand for bike sharing is that building bike sharing docking stations near cycle paths can effectively promote demand for bike sharing (Kabak et al., 2018).

In terms of land use attributes, slope is one of the most important natural land variables affecting bicycle use (Eren and Uz, 2020). Studies have revealed that the demand for cycling is best promoted by relatively moderate slope of land or flat terrain, as opposed to steep slopes, to both male and female commuters (Sener et al., 2009). Bordagaray et al. (2016) showed that steep hills reduce the demand for bike sharing. Moreover, steep hills cause cyclists to use more energy during the ride, resulting in bike sharing users borrowing bikes from up-hill stations and returning them at stations below (Eren and Uz, 2020). Indeed, Frade and Ribeiro (2014) argue

that the potential safety hazards caused by the speed of bikes going downhill on steep slopes cannot be ignored, which further explains the low demand for bicycles in many hilly areas of China and the difficulty of running bike sharing programmes there (Eren and Uz, 2020).

2.2.3 Safety Factors

High safety is considered to be an important factor in increasing demand for cycling trips and promoting the introduction of bike sharing programmes (Bakogiannis et al., 2019; Eren and Uz, 2020). As bike sharing programmes have become increasingly prevalent in developed countries, safety concerns have become a significant impediment to full participation (Bakogiannis et al., 2019; E. Fishman et al., 2012). Bonyun et al. (2012) state that bike sharing users can prevent head injuries and even avoid death when interacting with motorized traffic during rush hour by wearing a helmet appropriately. Basch (2014) revealed that the helmet-wearing rate of bike sharing users is much lower than that of private riders, resulting in a potentially higher traffic risk for bike sharing users. However, Fishman et al. (2014b) argue that bike sharing users are not reluctant to wear helmets; they just do not want to carry helmets with them. A solution to the problem of bike sharing users not wearing helmets might be providing helmets as part of the bike sharing programmes. Moreover, Fishman and Schepers (2018) state that bike sharing programmes introducing more safety-focused measures might be beneficial for stimulating user demand.

The above literature enumerates relatively major factors currently affecting demand for bicycle sharing, with rainfall in particular showing a negative correlation with demand for bicycle sharing trips in all studies (Eren and Uz, 2020). Focusing more attention on the factors influencing bike sharing demand might give planners or decision-makers reliable estimates to help them better implement bike sharing programmes.

2.3 Operation and Implementation of Bike Sharing Programmes

An ideal business model for a bike sharing programme focuses on making its services accessible and convenient (Zhang et al., 2015). However, Lewis and Roehrich (2010) state that operating bike sharing programmes is a challenging task, given the balance that operators are

expected to strike between complexity of both infrastructure and transactions. Therefore, it is particularly important to have a precise understanding of the challenges and drivers at play in the operation of such programmes.

Bicycle redistribution is identified as a major challenge for bike sharing operations (Pfrommer et al., 2014; Shaheen et al., 2012b). Pfrommer et al. (2014) revealed that many employees choose shared bicycles to commute to work. However, most shared bicycles are concentrated in city centres or business districts; the distribution in urban fringes and some more rural communities is relatively insufficient (Fishman et al., 2013). To solve this issue, operators should redistribute bicycles throughout the network according to demand. For instance, motorised vehicles and vans can be utilised to redistribute bicycles to various docking stations during the day to achieve a generally equitable distribution (Fishman et al., 2014a). However, Zhang and Mi (2018) have argued that bike sharing companies prefer to use cheap labour to redistribute bikes in the evenings, resulting in an inequitable distribution of shared bikes during peak commuting hours during the day. This remains difficult to address effectively. In addition, the difficulty of redistributing shared bicycles lies in their high transportation costs and complex practical attributes (Shaheen et al., 2012b).

Other challenges that need to be actively addressed in bike sharing operations include inherent user prejudices about cycling being unsafe, negative perceptions linking poverty and cycling in some cultures, and legal issues such as mandatory helmet legislation in Australia (Shaheen et al., 2012b). Examples of driving factors in the operation of bike sharing programmes are the establishment of cooperative relationships with local governments and community stakeholders and public outreach (e.g. a user feedback platform) (Ricci, 2015). Furthermore, Ricci (2015) suggests investing in more technological applications to enhance bike sharing development in terms of safety and convenience.

Several additional factors are necessary for the optimal operation and implementation of bike sharing programmes. Commonly, inflexible business models and single operational strategies cannot effectively adapt bike sharing to the characteristics of different regional contexts (Nikitas, 2019). Therefore, explicit policy support from local government is considered necessary for the popularity and development of bike sharing (Nikitas, 2019). For example, Lyu et al. (2021) suggest the public sector might consider integrating bike sharing

programmes when undertaking new city planning projects. Furthermore, the government's role as regulator is crucial: Aldred (2012) states that if the government only relies on citizens to self-monitor and take responsibility for using shared bicycles, a bike sharing programme will never work in harmony with public transportation.

To conclude, the effectiveness of bike sharing programmes is inextricably linked to close cooperation between government and bike sharing companies (Lyu et al., 2021), as well as those companies and public transport providers (Shaheen, 2012b). Meanwhile, bike sharing operations need to be interdependent with stakeholders (Frow and Payne, 2011).

2.4 Summary

It has been nearly 60 years since the first generation of bike sharing was introduced. On the one hand, bike sharing systems have evolved over four generations to become more and more sophisticated. On the other hand, with the continuous development of bike sharing and its popularity worldwide, bike sharing research 'databases' have been gradually enriched. The current research on shared bicycles mainly discusses motivating factors for the implementation of shared bicycles, the demand factors affecting the use of those bicycles, and the implementation and operation of such programmes. The literature shows that the emergence of bike sharing programmes has perfectly compensated for the previous shortcomings of walking between public transport stops and that bike sharing as a complement to public transport has significantly improved commuting efficiency and the convenience of travel while effectively solving last and first mile issues. Meanwhile, bike sharing can contribute to sustainable development by reducing carbon and nitrogen oxide emissions and improving the environment. In addition, studies have confirmed that bike sharing positively impacts public health, including but not limited to reducing the incidence of obesity and diabetes.

Factors that influence the demand for bike sharing as well as whether a bike sharing programme can be successfully developed and implemented include natural factors such as weather and climate, land use and the built environment, as well as the safety factors most relevant to the users themselves. All this makes it a complex and challenging task to develop and operate a bike sharing programme. Furthermore, sustainable bike sharing programmes

require operators to work together with local authorities, paying attention to solving several problems such as misallocation of bike numbers.

Table 1. Summary of Current Literature.

Research Topics	Key Ideas	Key References	Key Findings
The Motivations for Bike Sharing Programmes	1. Convenience	(Fishman et al., 2013; Shaheen et al., 2012b, 2011)	Point-to-point travel, round trips and rapid access via docking stations provided by bike sharing programmes promote connections to public transport hubs.
	2. Time and Financial Savings	(Buehler et al., 2014; Bullock et al., 2017)	The time saved in commuting may be used for additional work and may help to create other economic benefits.
	3. Easing Traffic Congestion	(Bachand-Marleau et al., 2012; Fishman et al., 2013)	Bike sharing has a positive effect on easing traffic congestion by replacing private car trips.
Factors Influencing Demand for Bike Sharing Trips	1. Weather and Climate Factors	(Eren and Uz, 2020; Gallop et al., 2011)	Climate and weather directly affect the demand for bike sharing by influencing the safety and convenience of such travel.
	2. Built Environment and Land Use Factors	(Eren and Uz, 2020; Schoner and Levinson, 2014)	Expanding the existing cycle network and putting in new, well maintained and robust infrastructure will increase the number of people commuting by bike. Slope is one of the most important natural land variables affecting bicycle use.
	3. Safety Factors	(Bakogiannis et al., 2019; Eren and Uz, 2020)	High safety is an important factor in increasing demand for cycling trips and promoting the introduction of bike sharing programmes.
Operation and Implementation of Bike Sharing Programmes	1. Challenges	(Pfrommer et al., 2014; Shaheen et al., 2012b)	Bicycle redistribution is identified as a major challenge faced by bike sharing operations.
	2. Policies and Strategies	(Frow and Payne, 2011; Lyu et al., 2021)	Effective bike sharing projects are often funded by local governments or private companies, and a bike sharing operation requires interdependence with stakeholders.

In general, the current literature on bicycle sharing focuses on the motivational influences and operational characteristics surrounding the development of bike sharing programmes and attempts to assess the benefits of bike sharing programmes in quantitative terms. Meanwhile, the current research literature on bike sharing comes mainly from Western countries and first-tier cities in China. There is a relative lack of study of the perceptions of bike sharing users, a bottom-up approach that is crucial to understanding user needs and difficult to study quantitatively. In addition, research on the operation and development of bike sharing in second and third-tier cities in China remains worryingly ambiguous. Therefore, this dissertation fills these gaps by investigating users' perceptions of bike sharing programmes in Jinan, a second-tier city in China.

3. Case Study and Methodology

3.1 Study Area

Jinan is the capital city of Shandong Province, China. It is located in east China, in west-central Shandong Province, and is known as the 'City of Fountains' because of its many springs and 72 famous fountains. As of 2021, Jinan City has ten districts and two counties under its jurisdiction, with a total area of 10,244.45 km² and a population of approximately 9.34 million. The main reason for choosing Jinan as the research area for this user opinion survey of bike sharing programmes is that the traffic congestion in Jinan is severe. Even though it is a second-tier city, Jinan's traffic congestion rate even once surpassed that of China's mega-cities such as Beijing and Shanghai (Mou et al., 2020). The fundamental reason for the traffic in Jinan is the unique spatial layout of the belt-shaped city. Jinan is adjacent to the Taishan Mountains in the south and the Yellow River in the north. Due to these natural regional characteristics, Jinan has constantly been developing towards the east and west. The city's urban space is a ‘rubber band’ that is constantly being stretched, which causes commuting pressure in its east-west direction and the current traffic congestion situation. In this context, it is imperative to alleviate traffic congestion and the resulting problems through shared transport. As bike sharing is an important part of shared transport, a survey on the perceptions of bike sharing users in Jinan is vital to promote bike sharing development in the city.

Meanwhile, the second-tier city of Jinan faces more severe traffic problems than China’s first-tier cities or even mega-cities, making the choice of Jinan more meaningful and the feedback from the city’s bike sharing users relatively more valuable. Finally, the Jinan bike sharing project contains the three most dominant brands currently on the market in mainland China, including the Meituan Bicycle (the former Mobike now acquired by Meituan and renamed ‘Meituan Bicycle’), the Qingju Bicycle and the Haro Bicycle. Therefore, the study of the Jinan bike sharing programme can representatively expand the database of bike sharing operations in China by understanding the suggestions of bike sharing users for the operation of these programmes.

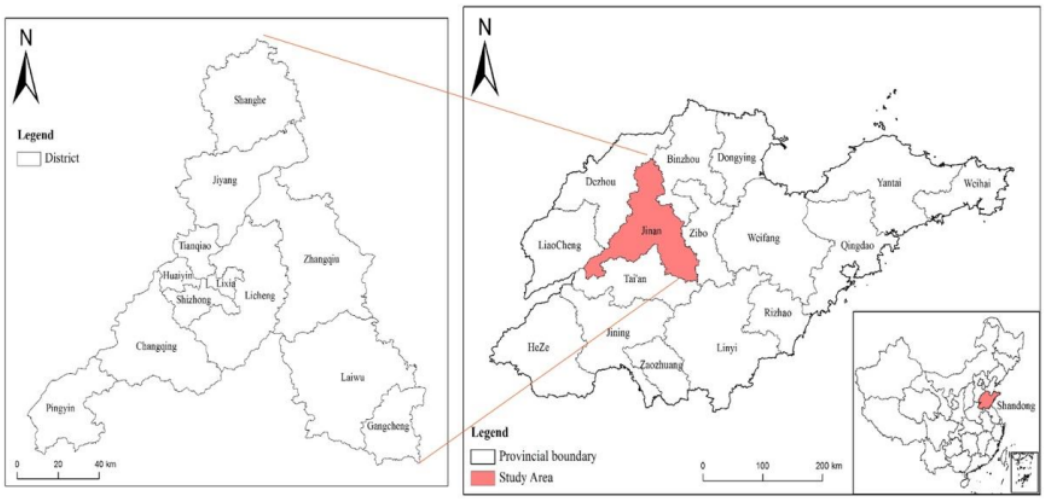

Figure 1. Location of Jinan.

3.2 Methodology

An important goal of qualitative research is the capturing of information by focusing on participants' words to better understand their thoughts, feelings and perceptions (Bernard, 2013). In qualitative research, semi-structured interviews are often used to explore participants' opinions, experiences and attitudes to determine why individuals behave in a specific manner. They are also employed to provide suggestions for practice development or modification and are helpful for data collecting (Harvey-Jordan and Long, 2001).

In this context, analysing the results of the semi-structured interviews undertaken can help us better understand users' views and suggestions regarding Jinan's bike sharing programme. This dissertation uses semi-structured interviews with 25 bike sharing users, including 14 males and 11 females (a ratio of 56% male to 44% female), whose data is summarised in Table 2. Respondents were recruited through a purposive sampling method that enabled the selection of those who had experience with bike sharing and were willing to comment on these (Bernard, 2017). These respondents were most likely to provide relevant and helpful data (Campbell et al., 2020). Respondents were furthermore selected according to their job type, including accountants, government employees, architects, graduate students, bank employees, doctors, and so on. The age range of respondents was 21 to 45 years (20% of respondents were between

21 and 25 years old; 32% were between 26 and 30 years old; 24% were between 31 and 35 years old; 16% were between 26 and 40 years old; 8% were between 41 and 45 years old). Due to the COVID-19 pandemic, semi-structured interviews were selected to conduct online. Each interview lasted between 30 and 45 minutes and was conducted between June and July 2022.

To achieve its purpose, the study discusses the following three main subjects: 1) the advantages of the bike sharing programme in Jinan; 2) the disadvantages of the bike sharing programme in Jinan; 3) how the bike sharing programme in Jinan might be improved.

Table 2. Profiles of Participants.

Number	Sex	Age	Job
1	Male	21-25	Student
2	Male	21-25	Student
3	Male	21-25	Student
4	Male	21-25	Bank clerk
5	Female	21-25	Accountant
6	Male	26-30	Doctor
7	Male	26-30	Bank account manager
8	Female	26-30	Teacher
9	Female	26-30	Real estate agent
10	Female	26-30	Marketing manager
11	Female	26-30	Nurse
12	Female	26-30	City planner
13	Female	26-30	Sales
14	Male	31-35	Automotive engineer
15	Male	31-35	Self-employed
16	Male	31-35	Composer
17	Male	31-35	Game developer
18	Female	31-35	Executive assistant
19	Female	31-35	Secretary
20	Male	36-40	Civil engineer
21	Male	36-40	Financial analyst
22	Male	36-40	Trader
23	Female	36-40	Unemployed
24	Male	41-45	Financial manager
25	Female	41-45	College professor

4. Findings and Discussion

4.1 The Advantages of the Bike Sharing Programme in Jinan

4.1.1 Convenience

According to the respondents, convenience was the primary motivation for using the bike sharing programme. Convenience incorporates the following three main areas: 1) the ease of access to shared bikes; 2) the ease of use of shared bikes; 3) the lack of worries after the shared bikes have been used. For instance, users can easily find bikes of all brands in the centre of Jinan, in commercial areas and on the roadside in all high-demand bike sharing areas. People do not have to spend a lot of time walking to find bikes during rush hour or on their daily commute. The respondents acknowledged the ease of understanding and operating the bike sharing process: registration, booking, unlocking, locating and payment are all done via smartphone (Chen et al., 2020; Shen et al., 2018).

"It's so convenient now that I can download the bike sharing app from my smartphone and the registration and authentication process is very easy. Once I become a shared bike user, I can use my phone to locate and navigate my way to the available bikes in my neighbourhood, and I can even book a bike in advance."

(Interviewee 16, Male, 11/06/2022)

"To use the bikes, all you need to do is scan the QR code on the bikes to unlock them, and you can pay directly online via payment apps."

(Interviewee 17, Female, 03/06/2022)

"I spend nearly two and a half hours on daily commuting due to traffic congestion, which makes me feel exhausted. The advent of bicycle sharing at least makes the journey from the station to home a little easier because I don't have to walk."

(Interviewee 7, Male, 12/06/2022)

The emergence of the bicycle sharing programme goes a long way towards addressing many of the concerns of users. The programme has eliminated the dilemma of not being able to bring a personal bike on public transport, as commuters can find and rent a bike on the side of the road after getting off the bus or metro and reaching their destination (D'Almeida et al.,

2021; Li et al., 2021). Besides, unlike when they travel on a personal bike, users do not have to face the dilemma of finding a place to park it (Ni and Chen, 2020). And when they encounter problems such as flat tires or bike breakdowns during the ride, all they need to do is get a new bike. In addition, the current bike sharing programme in Jinan is for all intents and purposes a dock-less programme, so users do not face the problem of having to return their bikes to a designated parking spot when they park (Chen et al., 2020; Fishman et al., 2014a).

"When I go out on my bicycle, I often worry about the bike being stolen and need to bring the lock with me. Sometimes it takes a lot of time to find the bike when I park it in one place, which is very inconvenient. The emergence of shared bicycles has effectively helped me avoid a lot of worries and troubles."

(Interviewee 5, Female, 05/06/2022)

4.1.2 Time Saving

Time saving is another crucial reason why users choose to use shared bikes. Jinan is a city well-known for its traffic jams. Users who choose to travel by private car and bus often face this issue. Traffic jams not only waste much time but also make commuting unpleasant. In contrast, bicycles can travel relatively flexibly in congested traffic environments without being affected by the congestion, saving much time and bringing riders a more pleasant commuting experience (Qiu and He, 2018). At the same time, as an effective way to solve the first and last mile of public transportation, sharing bikes saves commuters the time of transferring between various public transportation hubs on foot (Teixeira et al., 2021). Furthermore, shared bikes offer users a mode of travel that combines public transportation and cycling for the most efficient and quick way to get to their destination (Chen et al., 2020).

"Every time I take the bus, I have to follow a fixed route and often have to make a detour to get to my destination. The introduction of bike sharing has provided me with the easiest and shortest way to commute to work. I can get off at the nearest stop to my destination on the bus and rent a bike for the rest of the distance to get there quickly, which saves me a lot of time."

(Interviewee 3, Male, 10/06/2022)

"The roads in Jinan are congested at rush hour every day. But as a bike sharing user I am not

bothered by the traffic jams, and I enjoy the experience of cycling."

(Interviewee 8, Female, 13/06/2022)

"It's still a long walk from my house to the metro station, but with shared bikes, I can get to the station quickly every day, and it feels like the metro station is built right on my doorstep."

(Interviewee 4, Male, 16/06/2022)

4.1.3 Saving Money

The outstanding advantages of financial savings are an important reason many users consider bike sharing programmes the best way to get around (Lyu et al., 2021). Currently, bicycle sharing in Jinan no longer requires a deposit to be paid, which is a considerable saving compared to the previous model, where deposits of 99 to 299 RMB were required. All three of the bike sharing companies currently operating in Jinan have launched monthly bike sharing subscriptions where users pay less than 15 RMB per month, which translates to 0.5 RMB per day for unlimited bike sharing rides (15 RMB ≈ £1.83, 0.5 RMB ≈ £0.061). This low price is affordable for most classes of users. On the one hand, there is no need for non-professional cyclists to spend much money on bikes, because while private bikes may be superior to shared bikes in terms of performance, as mentioned above, they are far less convenient when travelling. On the other hand, for short journeys, shared bikes are far more cost-effective than buses and taxis, with a single bus ride in Jinan currently costing 2 RMB (2 RMB ≈ £0.24), while taxis start at a subjective 13 RMB (13 RMB ≈ £1.58) and are subject to traffic jams. Thus, most respondents consider shared bikes to be the best way to get around.

"I feel that bike sharing is the most cost-effective way to travel."

(Interviewee 2, Male, 01/06/2022)

4.2 The Disadvantages of the Bike Sharing Programme in Jinan

4.2.1 The Serious Problem of Indiscriminate Parking of Shared Bicycles

One of the significant advantages of the bike sharing programme is that access to and parking of bicycles are more flexible and convenient compared to the parking of private

bicycles. However, this flexibility has resulted in a significant increase in the random parking of shared bicycles, which not only disrupts the order of traffic but also affects the everyday lives of residents (Wang et al., 2021). The indiscriminate parking of shared bicycles has severely impacted other shared bicycle users and also greatly impeded the movement of pedestrians and underground passengers (Chang et al., 2018; Shi et al., 2018). If the parking of shared bicycles is not regulated, a bike sharing programme will not only run counter to the original intention of solving the problem of last mile of citizens' travel but will also add new problems, troubling public transport management.

The problem of indiscriminate parking of shared bicycles is caused by the following factors. Firstly, the quality of shared bike users varies, with a lack of self-discipline, a sense of luck and poor compliance with regulations being the main factors leading to unregulated parking of shared bikes (Jiang et al., 2019). Some users, after using shared bicycles, park their bicycles on blind walkways, lawns, and other areas that should not be used for parking shared bicycles, without regard for the inconvenience they may cause others (see Figure 2).

The second issue lies with the bicycle sharing enterprises. Nowadays, the bike sharing market is at the stage of rough and loose bicycle placement. Different bike sharing brands are operating large numbers of bikes in order to seize market share, but they lack penalties and effective guidance mechanisms for unreasonable behaviour such as indiscriminate parking by users (Jia et al., 2018; Lyu et al., 2021).

Thirdly, there are problems on the part of the government. Although the bike sharing industry is business-led, government guidance is vital for the sustainable development of bike sharing (Zhang et al., 2015). Nowadays, the government's shortcomings in developing bicycle sharing programmes are the lack of regulatory efforts and constraints on bicycle sharing operators and the lack of punitive measures against indiscriminate parking behaviour (Jiang et al., 2019).

The cost of making such parking mistakes is meagre, as users are often not directly punished for parking indiscriminately (Jiang et al., 2019). Moreover, the lack of proper guidance has led many shared bicycle users to follow the trend of unregulated bicycle parking, and the problem of indiscriminate parking has not been solved. Under such circumstances,

without the forming of a standardised system of parking for non-motorised vehicles in the city, this problem may become a vicious circle and increasingly challenging to regulate.

'The problem of indiscriminate parking of shared bicycles in Jinan is too severe. Piles of shared bikes are everywhere in the streets and lanes; in blind lanes, and even in the green belts, there are abandoned and unused shared bicycles. I think this phenomenon has a significant impact on Jinan's city image."

(Interviewee 18, Female, 22/06/2022)

"Bikes that are neatly placed during the day are stacked outside the entrance to the neighbourhood at night and can even take up the motorway. This not only affects the city's image but also has a negative impact on the public's everyday travel."

(Interviewee 14, Male, 07/06/2022)

Figure 2. Shared Bicycles Left Lying on the Roadside

4.2.2 Malicious Vandalism and Unregulated Use of Shared Bicycles

The emergence of bike sharing has brought great convenience to the public but has also brought with it all sorts of damage (Lyu et al., 2021; Nikitas, 2019). Since the launch of shared bicycles, there have been various acts of human damage to the bicycles. Shared bicycles face damage such as being thrown into the river, having their QR codes broken and having their parts dismantled (Jia et al., 2018). In addition, some people have turned shared bicycles into private bicycles by destroying the QR codes and locks and placing them near their homes, increasing their own convenience and avoiding the rental fees (see Figure 3, Figure 4).

In the early days of bike sharing, most bikes were government-issued docked bikes that required a card at a designated department and had to be parked at a designated parking station; this was not convenient (Jiang et al., 2019). Nowadays, bicycle sharing led by enterprises takes place in the context of the Internet+, which adopts GPS positioning technology to allow bicycles to be parked as they are used; this is convenient and efficient (Chen et al., 2020). However, this great convenience has dramatically reduced the cost of crime for criminals and allowed them to take advantage. Moreover, as shared bikes are public goods, even if there are quality problems with them such as broken seats or malfunctioning brakes, users will not fix them but instead simply replace them. With the mindset that it does not matter if a bicycle breaks, some bicycle users do not take care of their bicycles when using them, causing them to break faster. Finally, shared bicycles are also affected by the weather. On the one hand, bicycles exposed to open space are subject to erosion and rusting in rain and snow. On the other hand, slippery roads and unresponsive locks and positioning systems in the rain, snow and cold winter months make the safety of bicycles a hidden risk, accelerating damage to bicycles.

"I am very disappointed with those who do not take care of their shared bicycles during use."

(Interviewee 24, Male, 23/06/2022)

"I sometimes walk on roads and see that the locks and QR codes on shared bikes have been destroyed and replaced by private locks; I despise those behaviours."

(Interviewee 1, Male, 02/06/2022)

"The signs of deliberate vandalism on many shared bicycles are too obvious. Those damage marks are by no means the result of unregulated use."

(Interviewee 11, Female, 27/06/2022)

"I want to urge people to travel in a civilised manner, and if I encounter malicious damage to shared bicycles, I will discourage it then and there."

(Interviewee 25, Female, 24/06/2022)

Figure 3. Private Locking of Shared Bicycle

Figure 4. Vandalised QR Code of a Shared Bicycle

4.2.3 The Problem of Uneven Distribution of Shared Bicycles

The uneven distribution of shared bicycles is also a significant challenge to the sustainable development of bike sharing schemes (Lyu et al., 2021; Ma et al., 2021). Respondents indicated an over-distribution of shared bikes in the city centre and the commercial areas of Jinan, as well as near railway stations. The over-deployment of shared bikes has even taken over large pavement areas, obstructing pedestrians. In contrast, there is a significant lack of shared bikes in some communities and on the city's fringes. One of the central values of bike sharing as an effective solution to the first and last mile problem is that it helps commuters living on the edge

of the city or relatively far from the city centre to connect to public transport such as the metro or bus. Ironically, commuters living far from the city centre still do not enjoy the convenience of reaching public transport transit stations via shared bikes because of the lack of bikes available in their areas.

"The distribution of shared bicycles in the city centre is too dense, especially during the holidays, the sidewalks are full of shared bicycles. Not only does the excessive placement of shared bikes affect private bicycle parking, but also makes it difficult for pedestrians to pass."

(Interviewee 21, Male, 30/06/2022)

"My home is in the southern part of Jinan, on the edge of the city, and I can hardly see any shared bicycles around my home. Every day I have to ride my electric bike to the underground station and then change to the underground to go to work."

(Interviewee 4, Male, 16/06/2022)

4.3 How Might the Bike Sharing Programme be Improved?

4.3.1 Responsibility of the Government

In response to the problems arising in the bike sharing programme's operation, interviewees stated that they believed government departments should actively take on regulatory responsibilities and further refine and clarify the responsibilities of both operators and users by revising and improving the regulations for bike sharing.

One issue is that the current bike sharing companies are trying to maximize their market share and profits by providing many bikes (Jia et al., 2018; Lyu et al., 2021). In this context, these companies focus on the quantity of bikes they launch and neglect to maintain the quality of these bikes. Therefore, as an intervener, the government should establish a mechanism to evaluate the service level of bike sharing operators, regularly evaluate their service capability, cooperation level and other indicators, and reasonably optimise their market quota. Secondly, the credit system of users should be strengthened by linking the degree of regulation individuals experience when using shared bicycles to their creditworthiness; those with low creditworthiness should be included in the deny list to increase the cost of users' breach of trust (Cao et al., 2021; Lan et al., 2017).

In addition, respondents considered the Jinan government's promotion and publicity of bike sharing to have been too weak. They did not see the government's determination to govern and promote the bike sharing programme. Therefore, the government should step up publicity regarding the norms of bike sharing use and traffic safety by working with local new media to promote the civilised use of shared bicycles and expose users' violations of the law in the course of using shared bicycles (Jia et al., 2018). Citizens and the new media should be given full play in monitoring and guiding the regulation of shared bicycle use (Jia et al., 2018; Yang and Long, 2016): through establishing a network system involving the whole community in monitoring, efforts can be made to form an overall civilised atmosphere.

"I strongly suggest that the government intervene to improve the service abilities of bike sharing companies."

(Interviewee 19, Female,18/06/2022)

"Local governments should work with the media to expose the illegal and unlawful use of shared bikes and pull the deny list on users who behave uncivilly in using shared bicycles."

(Interviewee 25, Female, 24/06/2022)

"As far as I can remember, Jinan has never had a substantial event to promote and publicise bike sharing on a large scale."

(Interviewee 23, Female, 15/06/2022)

4.3.2 Responsibility of the Operators

Clearly, bike sharing operators have a large role to play in the improvement of bike sharing programmes. On the one hand, operators should make full use of the data on users' views and sentiments regarding bike sharing which is reflected by big data platforms (Song, 2021). Meanwhile, they should provide a reasonable number of shared bikes, guided by scientific calculations and field surveys, and reasonably divide the parking areas to avoid the phenomenon of over-crowded or unevenly placed shared bikes.

Bike sharing companies can optimise their programmes by developing new technologies, such as electric fences (Zhang et al., 2019). By replacing the manual locking of all shared bikes with locking via smartphones, the system can use location tracking to determine whether the

user's return location is in a civilised parking area and issue a lock-off command if so. If, however, the user is attempting to park in a non-parking spot, they will be reminded that parking is prohibited in that area and will continue to be charged until they park their bike in a designated area.

In addition, bike sharing operators should actively engage with the government; this is vital for the sustainability of bike sharing programmes (D. Zhang et al., 2015). For example, a bike sharing supervision platform could be established in cooperation with the government. By monitoring the number of shared bicycles in the city as well as real-time information on faulty and broken bicycles, cooperative and intelligent management of shared bicycles can be achieved.

"Bike sharing operators should rationalise the distribution of shared bikes so that people on the edge of the city can enjoy the convenience of cycling just like those in the city centre."

(Interviewee 4, Male, 16/06/2022)

"Operators can hardly achieve the ideal development of bicycle sharing business without public-private partnerships."

(Interviewee 12, Female, 20/06/2022)

4.4 Discussion

The interviews conducted revealed that the main reasons users choose shared bikes are convenience, time savings and financial savings. These findings are largely consistent with the current research (Buehler et al., 2014; Martin and Shaheen, 2014; Si et al., 2020).

One finding which stands in stark contrast to those of studies conducted in Western countries was that while the users interviewed acknowledged the health-related as well as environmental benefits of bike sharing, they said they would not choose shared bikes purely for exercise and environmental protection purposes (Buehler et al., 2014; Woodcock et al., 2014). The similarities and differences in motivations for bike sharing between users in Jinan and Western countries can probably be attributed to the difference in commuting times in these places, which are directly related to the level of traffic congestion. Giménez-Nadal et al. (2020) state that the average commute time in Mediterranean countries is generally under 37 minutes.

Even in countries such as the UK, Germany, Denmark and Finland, where commuting times are considered to be relatively long for the West, the average commuting time is between 40 and 50 minutes (Giménez-Nadal et al., 2020). However, during the interviews in Jinan, some respondents reported spending up to two and a half hours on their daily commute.

Against the backdrop of the enormous pressure to commute every day, the significance of bike sharing for users in Jinan can be summarised in two aspects: 1) it can solve the first and last mile problem; 2) it is an alternative to walking as a means of transferring between various transport hubs. Therefore, Jinan bike sharing users are most concerned with quantifiable factors directly related to their own benefits when choosing bike sharing trips. But if bike sharing is only considered a means of relieving traffic congestion and a tool for saving time and money, it might be abandoned when more efficient ways of commuting emerge, which would be contrary to the sustainable development goals of bike sharing programmes. It is therefore vital to learn from Western bicycle-friendly countries and work together on three fronts—bicycle infrastructure, cycling culture and government policy—so that users can enjoy the convenience of bicycle sharing and actively choose it for health and environmental reasons, rather than just passively choosing it to make their commute more efficient.

The three major factors hindering Jinan users from using shared bicycles are unregulated parking of shared bicycles, vandalism of shared bicycles and uneven distribution of shared bicycles; this finding is consistent with those of previous studies (Liu et al., 2019; Lyu et al., 2021; Shaheen et al., 2010; Shi et al., 2019).

The lack of standards and laws governing shared bicycle use is a major cause of vandalism and unregulated use. Zhu et al. (2018) argue that the influence of norms on individual behaviour varies between individuals with different moral values: as a result, some users in Jinan may lack an understanding of the definition of regulated use of shared bicycles, leading them to use or even take possession shared bicycles in an unregulated or even illegal manner with their own interests at heart. Meanwhile, Chi et al. (2020) assert that the current government's main regulatory target and legal objective are the bike sharing companies. This means there are relatively insufficient policy measures for the restraint of unregulated use of bikes by bike sharing users, which gives some self-serving individuals the opportunity to take advantage of the system.

The uneven distribution of shared bikes is due to unfavourable provider operations. Due to the rapid growth of the bike sharing industry, many bike sharing brands are striving to capture the market and quickly maximise profits (Jia et al., 2018; Lyu et al., 2021). The excessive pursuit of profits has led operators to place a large number of shared bikes in city centres and commercial areas while ignoring the urgent demand for shared bikes from residents on the urban fringe. Due to the high prices and rents of city centre housing, many people choose to rent in relatively remote areas of the city, where rents are lower. However, these areas are often far from metro stations, making an already tight commute even more challenging. Bike sharing fulfils a practical need for the general public, as it is an effective way to solve the first and last mile problem. However, on the urban fringe, there is an insufficient supply of shared bikes. Even more ironically, bike sharing in city centres has seriously overwhelmed the space available on city centre streets and impeded the normal flow of pedestrians. This study therefore argues that even if it is not possible to have as ample a supply of bikes as in the city centre on the fringes, bike sharing operators should at least adequately investigate the demand for shared bikes in each neighbourhood and distribute bikes according to demand.

The interviews also provide guidance on possible improvements to the development of the Jinan bike sharing project, which may serve as a model for other Chinese cities and other developing countries. As Ricci (2015) points out, a successful bike sharing programme inevitably involves a tripartite collaboration between the operator, the public user and the local government. Firstly, focus should be placed on strengthening the regulation of the bike sharing industry (Jia et al., 2018). The development of shared bicycle programmes needs to further refine and clarify the regulatory responsibilities of government departments as well as the main responsibilities of operators and users. Secondly, it is crucial to strengthen bicycle sharing programmes' technological innovation and guide positive competition in this market (Yang et al., 2019). For example, by using big data platforms to carry out scientific calculations, the number of shared bikes to be put on the market could be accurately determined to avoid phenomena such as over-placement or uneven placement. Zhang et al. (2019) also identified the necessity of advanced technology and reasonable bike-share distribution. Thirdly, one could link individual bike sharing norms to personal creditworthiness and prohibit low-credit users

from using shared bikes; this suggestion is consistent with the conclusion reached by Lyu et al. (2021). In addition, Jinan can learn from foreign countries' bike sharing policies.

Policymakers should balance the development of bike sharing infrastructure with activities that help promote the public's choice of bike sharing; this is crucial for the better development of bike sharing programmes (Lewis and Roehrich, 2010). Currently, there is a relative lack of publicity for bike sharing activities and policies in Jinan. Moreover, Jinan, as a city with severe traffic congestion, does not operate odd-even schemes except for during significant events, whereas the odd-even schemes are already in place in many Chinese cities such as Beijing and Shanghai. The Jinan government's publicity is mainly superficial, and no substantive activities such as car-free days have ever been carried out. Therefore, subsequent bike sharing programmes in Jinan should focus on car-free days, bike-riding festivals, and odd-even schemes.

5. Conclusions and Future Research

5.1 Summary

Bike sharing programmes are seen as an effective way to solve problems such as traffic congestion and environmental pollution caused by the dramatic increase in motor vehicles. At the same time, bike sharing plays a vital role in solving the first and last mile problem attendant on public transport. As one of the countries with the largest number of motor vehicles in the world, it is imperative for China to achieve sustainable transport through bike sharing programmes. However, the current literature on bike sharing comes mainly from Western countries, and the literature on bike sharing in China mainly focuses on first-tier cities such as Beijing and Shanghai, with little research on bike sharing in second and third-tier cities. This dissertation takes Jinan, a second-tier city in China known for its traffic congestion, as its subject and aims to gain insight into users' perceptions of the development of the bike sharing project in Jinan using a semi-structured interview research method. In addition, the dissertation aims to expand the database of bike sharing research by understanding the factors that discourage and promote the use of bikes and collecting suggestions from users for the development of bike sharing programmes.

5.2 Key Findings

To better understand users' perspectives on the development of bike sharing programmes in Jinan, this dissertation aims to answer three questions. First, what are the motivating factors for users to use shared bicycles in Jinan? Second, what are the detrimental factors that hinder users' demand for bike sharing? Thirdly, what are users' suggestions for operating and developing the bike sharing programme in Jinan? The responses to these questions are presented below.

5.2.1 Question 1

The study found that bike sharing users in Jinan are more likely to be driven to use shared bicycles by benefits that can be quantified and which are directly reflected in convenience as well as time and money savings. In contrast, the Western literature shows that users cite

convenience, time-saving and financial savings as key drivers but also emphasise their health and environmental protection concerns (Buehler et al., 2014; Woodcock et al., 2014).

5.2.2 Question 2

The study shows that users resent the deliberate damage and unregulated use of bikes and believe these destructive behaviours severely impact their cycling experience. One of the recurring issues raised by shared bicycle users in Jinan is the damage to bicycles caused by deliberate vandalism. Therefore, on the one hand, it is vital to introduce policies that raise awareness of the need to regulate the use of shared bicycles (Chi et al., 2020). On the other hand, developing a corresponding punishment mechanism for the non-compliant use of bicycles is necessary (Jia et al., 2018; Richards et al., 2012). In addition, the uneven distribution of shared bicycles and unregulated parking are also important factors preventing users from making use of shared bicycles.

5.2.3 Question 3

Firstly, this study argues that the sustainable development of bike sharing programmes requires government intervention and regulation; operators to take responsibility for maintenance, supervision and technology development; and users to take responsibility for rational and regulated use. Such tripartite cooperation is optimal for the sustainable development of bike sharing projects (Lyu et al., 2021). Meanwhile, this study suggests that when improving bike sharing infrastructure, operators should try to introduce new technological tools such as big data platforms and electric fences to promote better development of bike sharing (Song, 2021). Moreover, policymakers should also focus on developing specific bike sharing-related activities rather than just superficial promotion, which could draw on experience from Western countries (Lewis and Roehrich, 2010).

5.3 Contributions

This dissertation aims to gain insight into users' perceptions of the development of the bike sharing project in Jinan through a semi-structured interview research method. Previous studies

have lacked research on second-and third-tier cities as well as a bottom-up approach to explore bike sharing development from the user's perspective. By studying Jinan, a second-tier traffic congestion-heavy city in China, a contribution is made to expanding the database of information on the development of bike sharing programmes.

First, this dissertation argues that the passive choice of bicycle sharing as a means of relieving the stress of commuting due to traffic congestion and the over-focus on the practical benefits of saving time and money are not conducive to the sustainability of bicycle sharing programmes. Users need to actively choose bike sharing for various purposes, such as environmental protection and physical fitness, to make the bike sharing programme more sustainable in the long term. This dissertation therefore suggests learning from Western bicycle-friendly countries, for instance by building bicycle infrastructure which allows users to better enjoy the convenience of cycling (Nikitas, 2019). Secondly, it is vital for the sustainability of bike sharing programmes that operators put users first, rather than chasing profits and capturing market share excessively (Nikitas, 2019). Thirdly, the government should continue to improve and close the loopholes in implementing bike sharing programmes through policy intervention (Jia et al., 2018; Lyu et al., 2021).

Lyu et al. (2021) revealed that it is not enough to rely on the consciousness of bike sharing users alone; only a tripartite partnership between government, operators and users can make bike sharing schemes sustainable. On this basis, this thesis proposes linking the reputation of bike sharing users to the norms of use; this should reduce vandalism and unregulated use of bike sharing (Cao et al., 2021; Lan et al., 2017). Moreover, penalties should be introduced for non-regulated use of shared bicycles, and users who seriously violate the norms should be denied shared bicycle use.

5.4 Future Research

This study proposes two directions for future research. On the one hand, subsequent research could further focus on China's bike sharing programmes in other second-tier and third-tier cities. Meanwhile, the development of bike sharing projects in China might also be further promoted by drawing on the experiences of bike sharing development in other Asian cities. On

the other hand, given China's large population and wide range of bike sharing users, further research might focus on specific groups and improve the bike sharing programme by meeting the needs of various different demographics, such students in university towns, commuters living on a city's edge, and elderly people who cannot scan QR codes to use shared bicycles because they do not have smartphones.

5.5 Limitations

There are certain limitations to this study. For instance, there may be other users who chose or abandoned bike sharing use due to factors that were not included in the selection of bike sharing user interviewees. Thus, a larger sample of bike sharing users could be tested in further research.

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Appendix A. Interview Questions

1. Have you ever used a shared bike in Jinan?
2. How often do you use shared bikes in Jinan?
3. What do you think is the nature of running a bike sharing program?
4. What do you think are the advantages that the bike-sharing program brings to transportation in Jinan?
5. Do you think there are any disadvantages to the bicycle sharing program in Jinan?
6. Based on your experience, what are the incentives that have contributed to your demand for bike sharing in Jinan? (e.g. convenience, cost saving, time saving, health benefits, environmental friendliness, etc.)
7. Based on your experience, what are the factors that have discouraged you from using bike-sharing in Jinan? (e.g. safety issues, bicycle maintenance issues, operational and management issues, cultural issues, financial issues, etc.)
8. How do you consider the current situation of the development of the bike sharing program in Jinan?
9. Can you provide any suggestions in terms of policy for the development of the bike-sharing program in Jinan?
10. To better promote the bike sharing program in Jinan, what role do you think the local government should play in implementing the bike sharing program?

Appendix B. Consent Form

Consent Form

The title of the research project is ‘Investigating users' perspectives on bike-sharing in Jinan’. The study aims to enrich the data pool of bike-sharing research in second-tier cities by gaining insight into users' perceptions of the development of bike-sharing projects in Jinan. In order to better conduct the study, semi-structured interviews were used to conduct interviews from the following three aspects:

1. Motivations of bike-sharing users
2. Factors that hinder users from using bike-sharing
3. Users' suggestions for the development and operation of bike-sharing programs in Jinan

The purpose of this study is for an MSc dissertation (Transport and City planning) and the information provided will only be used for assessment purposes kept within the University.

Please read the following points and tick the boxes if you agree with them:

☐ I have been briefed about what the project is about and how the interview will work
☐ If I don’t want to answer a question, I can say so and I will not need to answer it
☐ I give permission for the interview to be audio recorded
☐ If I want a copy of the final report I know how to contact the researcher to arrange this
☐ I am aware that the information I give and the audio recording will be kept anonymous throughout the report
☐ I am aware that all the data will be destroyed after the project is over

For further queries following the interview please feel free to contact me, the researcher, below:

Name: Tiankuang Xu

Phone number: +44 07771 428745

Email: tiankuang.xu.21@ucl.ac.uk

Please sign below and return to the researcher if you agree with the information provided above

Signed ……

Name……...

Date……..……

Appendix C. Supervisor Sign-off for Ethical Clearance Forms and Risk Assessment Forms

(For supervisor completion only BEFORE submission via Moodle)

Are you satisfied with the **ethical clearance form** (*yes/no*)? ------ Yes.

There are no potential ethical issues based on the proposed methodology – semi-structured interviews.

Are you satisfied with the **risk assessment form** (*yes/no*)? ------- Yes.

There are no potential risks based on the proposed methodology – semi-structured interviews.

Note: this is a copy of the proforma that each student MUST complete and submit directly on Moodle. Please reproduce your submission here for the purpose of your supervisor signing off on its review and approval.

Appendix D. Ethical Clearance Pro Forma

It is important for you to include all relevant information about your research in this form, so that your supervisor can give you the best advice on how to proceed with your research.

You are advised to read though the relevant sections of UCL's Research Integrity guidance to learn more about your ethical obligations.

Submission Details

1. **Name of programme of study:**
   MSc Transport and City Planning

2. **Please indicate the type of research work you are doing (Delete that which do not apply):**
   Dissertation in Planning (MSc)

3. **Please provide the current working title of your research:**
   Investigating users' perspectives on bike-sharing in Jinan, a second-tier city in China

4. **Please indicate your supervisor's name:**
   Mengqiu Cao

Research Details

5. **Please indicate here which data collection methods you expect to use. (Tick all that apply/or delete those which do not apply.)**

- Online Semi-structured interviews

6. **Please indicate where your research will take place (delete that which does not apply):**
   - Overseas only

7. **Does your project involve the recruitment of participants?**
   'Participants' means human participants and their data (including sensor/locational data and observational notes/images.)

Yes

Appropriate Safeguard, Data Storage and Security

8. Will your research involve the collection and/or use of personal data?

Personal data is data which relates to a living individual who can be identified from that data or from the data and other information that is either currently held, or will be held by the data controller (you, as the researcher).

This includes:

- Any expression of opinion about the individual and any intentions of the data controller or any other person toward the individual.
- Sensor, location or visual data which may reveal information that enables the identification of a face, address etc. (some post codes cover only one property).
- Combinations of data which may reveal identifiable data, such as names, email/postal addresses, date of birth, ethnicity, descriptions of health diagnosis or conditions, computer IP address (of relating to a device with a single user).

Yes

9. Is your research using or collecting:

- special category data as defined by the General Data Protection Regulation*, and/or
- data which might be considered sensitive in some countries, cultures or contexts?

*Examples of special category data are data:

- which reveals racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership;
- concerning health (the physical or mental health of a person, including the provision of health care services);
- concerning sex life or sexual orientation;
- genetic or biometric data processed to uniquely identify a natural person.

No

10. Do you confirm that all personal data will be stored and processed in compliance with the General Data Protection Regulation (GDPR 2018)? (Choose one only, delete that which does not apply)

- Yes

11. I confirm that:

- The information in this form is accurate to the best of my knowledge.
- I will continue to reflect on and update these ethical considerations in consultation with my supervisor.

Yes

Appendix E. Risk Assessment Form

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

DEPARTMENT/SECTION: BARTLETT SCHOOL OF PLANNING

LOCATION(S): JINAN, CHINA

PERSONS COVERED BY THE RISK ASSESSMENT: TIANKUANG XU

BRIEF DESCRIPTION OF FIELDWORK (including geographic location):

Semi-structured interviews were used with respondents selected by the Purposive sampling method for bike-sharing users in Jinan

COVID-19 RELATED GENERIC RISK ASSESSMENT STATEMENT:

Coronavirus disease (COVID-19) is an infectious disease caused by coronavirus SARS-CoV-2. The virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Droplets fall on people in the vicinity and can be directly inhaled or picked up on the hands and transferred when someone touches their face. This risk assessment documents key risks associated fieldwork during a pandemic, but it is not exhaustive and will not be able to cover all known risks, globally. This assessment outlines principles adopted by UCL at an institutional level and it is necessarily general. Please use the open text box 'Other' to indicate any contingent risk factors and control measures you might encounter during the course of your dissertation research and writing.

Please refer to the Dissertation in Planning Guidance Document (available on Moodle) to help you complete this form.

Hazard 1: Risk of Covid -19 infection during research related travel and research related interactions with others (when face-to-face is possible and/or unavoidable)

Risk Level - Low

Existing Advisable Control Measures: Do not travel if you are unwell, particularly if you have COVID-19 symptoms. Self-isolate in line with NHS (or country-specific) guidance.

Avoid travelling and face-to-face interactions; if you need to travel and meet with others:

- If possible, avoid using public transport and cycle or walk instead.

- If you need to use public transport travel in off-peak times and follow transport provider's and

governmental guidelines.

- Maintain (2 metre) social distancing where possible and where 2 metre social distancing is not achievable, wear face covering.
- Wear face covering at all times in enclosed or indoor spaces.
- Use hand sanitiser prior to and after journey.
- Avoid consuming food or drinks, if possible, during journey.
- Avoid, if possible, interchanges when travelling - choose direct route.
- Face away from other persons. If you have to face a person ensure that the duration is as short as possible.
- Do not share any items i.e. stationary, tablets, laptops etc. If items need to be shared use disinfectant wipes to disinfect items prior to and after sharing.
- If meeting in a group for research purposes ensure you are following current country specific guidance on face-to-face meetings (i.e rule of 6 etc.)
- If and when possible meet outside and when not possible meet in venues with good ventilation (e.g. open a window)
- If you feel unwell during or after a meeting with others, inform others you have interacted with, self-isolate and get tested for Covid-19
- Avoid high noise areas as this mean the need to shout which increases risk of aerosol transmission of the virus.
- Follow one way circulation systems, if in place. Make sure to check before you visit a building.
- Always read and follow the visitors policy for the organisation you will be visiting.
- Flush toilets with toilet lid closed.

-'Other' Control Measures you will take (specify):

NOTE: The hazards and existing control measures above pertain to Covid-19 infection risks only. More generalised health and safety risk may exist due to remote field work activities and these are outlined in your Dissertation in Planning Guidance document. Please consider these as possible 'risk' factors in completing the remainder of this standard form. For more information also see: Guidance Framework for Fieldwork in Taught and MRes Programmes, 2021-22

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section. If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.

Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to**

	identify and assess any risks associated with this hazard
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low ? Low

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
✓	work abroad incorporates Foreign Office advice
	only accredited centres are used for rural field work
	participants will wear appropriate clothing and footwear for the specified environment
	refuge is available
	work in outside organisations is subject to their having satisfactory H&S procedures in place
✓	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: **Participants have been given all necessary information**

EMERGENCIES	Where emergencies may arise use space below to identify and assess any risks
e.g. fire, accidents	Examples of risk: loss of property, loss of life

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
✓	contact numbers for emergency services are known to all participants
✓	participants have means of contacting emergency services
	a plan for rescue has been formulated, all parties understand the procedure
	the plan for rescue /emergency has a reciprocal element
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EQUIPMENT	Is equipment used?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any

	risks	
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?	

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for equipment is followed
	participants have been provided with any necessary equipment appropriate for the work
	all equipment has been inspected, before issue, by a competent person
	all users have been advised of correct use
	special equipment is only issued to persons trained in its use by a competent person
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	**Is lone working a possibility?**	**YES**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. alone or in isolation lone interviews.	Examples of risk: difficult to summon help. Is the risk high / medium / low? **Low**		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for lone/out of hours working for field work is followed
	lone or isolated working is not allowed
✓	location, route and expected time of return of lone workers is logged daily before work commences
✓	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
✓	all workers are fully familiar with emergency procedures
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

ILL HEALTH	**The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.**
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? **Low**
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	all participants have had the necessary inoculations/ carry appropriate prophylactics
✓	participants have been advised of the physical demands of the research and are deemed to be physically suited
	participants have been adequate advice on harmful plants, animals and substances they may encounter
	participants who require medication should carry sufficient medication for their needs
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

TRANSPORT	**Will transport be required**	**NO**	✓	**Move to next hazard**
		YES		**Use space below to identify and assess any risks**
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low?			
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**			

	only public transport will be used
	the vehicle will be hired from a reputable supplier
	transport must be properly maintained in compliance with relevant national regulations
	drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
	drivers have been trained and hold the appropriate licence
	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
	sufficient spare parts carried to meet foreseeable emergencies
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	Will people be dealing with public	YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	all participants are trained in interviewing techniques
✓	advice and support from local groups has been sought
✓	participants do not wear clothes that might cause offence or attract unwanted attention
✓	interviews are conducted at neutral locations or where neither party could be at risk
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

WORKING ON OR NEAR WATER	Will people work on or near water?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	lone working on or near water will not be allowed
	coastguard information is understood; all work takes place outside those times when tides could prove a threat
	all participants are competent swimmers

	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
	boat is operated by a competent person
	all boats are equipped with an alternative means of propulsion e.g. oars
	participants have received any appropriate inoculations
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	**Do MH activities take place?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	the departmental written Arrangement for MH is followed
	the supervisor has attended a MH risk assessment course
	all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
	all persons performing MH tasks are adequately trained
	equipment components will be assembled on site
	any MH task outside the competence of staff will be done by contractors
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	the departmental written Arrangements for dealing with hazardous substances and waste are followed
	all participants are given information, training and protective equipment for hazardous substances they may encounter
	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
	waste is disposed of in a responsible manner
	suitable containers are provided for hazardous waste
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	Have you identified any other hazards?	NO	If 'No' move to next section If 'Yes' use space below to identify and assess any risks
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		
CONTROL MEASURES	**Give details of control measures in place to control the identified risks**		

Have you identified any risks that are not adequately controlled?	**NO**	✓	**Move to Declaration**
	YES		**Use space below to identify the risk and what action was taken**

DECLARATION	The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.
	Select the appropriate statement:

✓	I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk
	I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR Mengqiu Cao 3rd May 2022

BPLN0039_VNZK0

GRADEMARK REPORT

FINAL GRADE

/100

GENERAL COMMENTS

Instructor

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