THE POST-OLYMPIC SUSTAINABLE USAGE OF BEIJING OLYMPIC STADIUMS AND THE FOREST PARK

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ABSTRACT

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After 2008 Beijing Olympic Games, how to get the Olympic venues and the Forest Park reused in a sustainable way is a problem in front of Beijing government. Some stadiums and some houses in Olympic Village still remain vacant and even abandoned. Making these facilities sustainable reused can save a lot of money and energy. The aim of this study is to find out how to achieve the sustainable development and the post-Olympic sustainable reuse after the Olympic Games. This paper will adopt qualitative research methods including surveys and interviews done with local residents and visitors in the area where the Olympic stadiums and the Forest Park located in order to obtain their opinions and quantitative research methods including stadiums sustainable index to find out the current reused situation of Olympic venues and the Forest Park, the reasons why some stadiums were abandoned after the Games, and the recommendations to improve the current situation to achieve the three Es (economic, social equitable, environmental) of sustainability.

Dedicated to my beloved parents, Peilei, my friends, and God

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Chapter 1 Introduction

This chapter introduced the basic information of Beijing Olympic stadiums and Olympic Forest Park; presented the concept of sustainability and its relation with Olympic movement; described the research aims and objectives; and stated the researchable questions and hypothesis.

1.1 Overview of Beijing Olympic stadiums and Olympic Forest Park

The majority of the games were held in the Olympic Green located in Chaoyang district and University Area located in Handian district. Beijing Olympic Green consists of a dozen venues including National Stadium (Bird's Nest), Olympic Village with its associated facilities and a forest park. The Beijing Olympic Green can be divided into three parts. There are many stadiums located in the southern part of the Olympic Green. This area can be called Stadiums Area. People can find National Stadium (Bird's Nest), National Swimming Centre (Water Cube), and National Indoor Stadium there. In the southern part of the Stadiums Area in Beijing Olympic Green, all the stadiums which have already been built for 1990 Beijing Asian Olympics such as Yingdong Natatorium lie there occupying around 1.64 square kilometers. In the north, there stand many stadiums, all of which are totally new for 2008 Olympics such as National Stadium (Bird's Nest) and National Swimming Centre (Water Cube). During the period of 2008 Beijing Olympics, 22 venues were put into use. 10 of them were newly built. 8 of them were upgraded and expanded. 4 of them were temporary. (Xiaodi Zhu 2013)

In addition, some stadiums were located in Handian district. The majority of these stadiums were located in the University Area which were close to the Olympic Green including China Agricultural University Gymnasium, University of Science and Technology Beijing Gymnasium, and so on. Besides, some stadiums were located in other districts in Beijing.

Beijing Olympic forest park lies in the northern part of the Olympic Green. It is a large, man-made nature park and is located in the northern end of Central Axis of Beijing. It covers an area of 6.8 square kilometers. The park is oval in shape and features Lake Wa Biancun in the center. The north side of the lake has a mountain that gives an excellent view of this part of the city. It is called “the lung of the Beijing City” by many people.

1.2 Sustainability and Olympic movement

People realized the importance of keeping balance of human society and the surroundings in the ancient time. The early thought of sustainability started in 19th century. Some scientists and philosophers such as Friedrich Engels found many urban problems during that period and raised the concerns about the surroundings capability to sustain human beings. In 1960s, inspired by many scientists and philosophers, environmentalism emerged in the western world. This social movement mainly focused on ecosystem. People tried to protect natural resources and improve the health of environment in order to control some urban problems such as pollution and create a better environment for human beings. In 1970s, the Energy Crisis had a huge effect on the world. The OPEC increased the price of petrol in order to express their dissatisfaction to the western world, which rapidly resulted in the

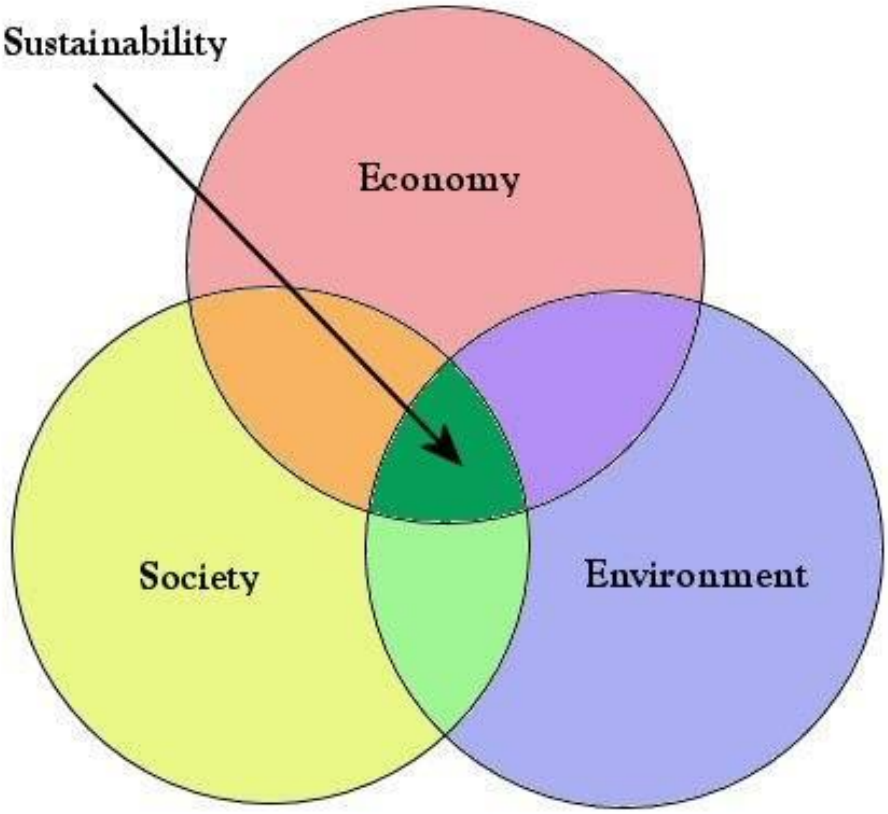
shortage of petrol all over the world. The Energy Crisis led to the economic crisis at length. In this case, both the governments and civil societies turned their attention to environment, natural resource, and sustainable development.

The concept of sustainability appeared for the first time within a human-environment context in the Club of Rome's *The Limit to the Growth* in 1972. (Igor Vojnovic 2013) The Club of Rome Executive Committee argued that "World's system is simply not ample enough nor generous enough to accommodate much longer such egocentric and conflictive behavior by its inhabitants." The Committee decided to purchase economic and environmental dimensions of sustainability in order to achieve the stable stage of human's society.

In 1974, another dimension of sustainability: social equity, was introduced to the public at the World Council of Churches. (Igor Vojnovic 2013) Equity and social justice were considered to be important parts of sustainable society after that very conference.

Then in 1987, the widely accepted concept of sustainability was introduced. According to the United Nation's definitions, "… sustainable development is development that is balanced between people's economic and social needs and the ability of the earth's resources and ecosystems to meet present and future needs." (World Commission on Environment and Development 1987) The 2005 World Summit on Social Development pointed out that sustainable development should include three Es: economic development, social equity, and environmental protection. (United Nations General Assembly 2005. 2005 World Summit Outcome) People usually use three different-colored overlapping ellipses illustrate this view. This following Venn diagram shows the relationship of economic development, social equity, and environmental protection.

Figure 1 3Es of sustainability



Source: http://secretaryofinnovation.com/wp-content/uploads/2010/09/sustainability-diagram1.png

Today two of the hottest buzzwords are sustainability and sustainable development. "…as the world population becomes increasingly aware of the decline in the abundance of natural resources and the importance of minimizing the human footprint on the natural landscape, communities have been coming together in order to create architectural solutions to address these global problems." (Andrea Blaser 2008)

As a result, both in architecture and post-Olympic usage communities, sustainability and sustainable development play an increasingly important role. "Leadership in Energy and Environmental Design (LEED) certification is quickly becoming an architectural standard, and mixed use developments that maximize available land are becoming normal developments as business leaders outside of the architectural community are beginning to see the merits of sustainable architecture and development." (Andrea Blaser 2008)

Meanwhile, after the Games, Some stadiums and some houses in Olympic Village still remain vacant and even abandoned. Making these facilities sustainable reused can save a lot of money and energy, which is relevant to the definition of sustainability and sustainable development.

Chinese authorities invested a large number of money to build this Olympic Green. As a result, it is very important to make Beijing's Olympic Green sustainable reused after Beijing Olympic Games in economic, social equitable, and environmental dimension.

1.3 Research aims and objectives

After 2008 Beijing Olympic Games, how to get the Olympic Green reused in a sustainable way is a problem in front of Beijing government. Some stadiums and some houses in Olympic Village still remain vacant and even abandoned. Making these facilities sustainable reused can save a lot of money and energy. "It is true from the outset that the high concentration implied by the Games in time (a two-week event), in space (one host city only) and in investment (the operating and infrastructure costs of the Games are in the billions) seems largely to contradict the concepts of sustainable development that advocate the dispersion and sharing of environmental, social and economic impacts across time and space for the benefit of all." (Philippe Furrer 2002)

In the history of the Olympic Games, many Olympic venues and facilities cannot be sustainable reused after the Games. The host cities invested a large number of money and resources building these venues and facilities. However, they cannot get benefits from these venues and facilities after the Games. As a result, money and resources will be wasted.

Sometimes, although some venues and facilities were still used after the Games, the residents living in the host cities may not easily enjoy convenience brought by these venues and facilities. For example, temple of Olympia is an Olympic park built for 2004 Athens. It is still used after the Olympic Games. However, this park is located far away from the urban area and the public transportation is not good there. The residents living in the urban area of Athens may not easily go there and enjoy this Olympic park after the Games. In conclusion, it is very important to make the venues and facilities sustainable reused and achieve three Es of sustainability after the Games.

The aim of this study is to find out how to achieve the sustainable development and the post-Olympic sustainable reuse after the Olympic Games. Through the case studies about the previous Olympic Games and the field trip to Beijing Olympic Green this summer, the researcher will introduce and analyze the current situation about the Olympic Green after the Games and the experience about the previous Olympic Games.

The objectives of this thesis include: research the current situation of the buildings and facilities in the Olympic Green; have a better understanding of the post-Olympic sustainable reuse; research the different styles of policy approach to achieve sustainable city from market-based towards deep green ecologically centered approaches.

1.4 Researchable questions and hypothesis

1.4.1 Researchable questions

The researchable questions of this thesis include the following questions. More specific questions will be set up later in this thesis.

- What is the current reused situation of Olympic venues and the Forest Park after the Games? How do the Beijing authorities do to have the buildings and facilities in the Olympic Green reused after the Games?

- Why and what measures adopted by Beijing government cause some buildings and facilities abandoned after the Games?

- How to improve the current situation in order to make the Olympic venues and the Forest Park sustainable reused and achieve the three Es of sustainability?

1.4.2 Hypothesis

Based on the researchable questions, the hypothesis of sustainable reuse of Beijing Olympic venues and the Forest Park includes the following points: The first is to make Olympic stadiums mix-used since the majority of which are huge and cover a lot of room in order to make money from themselves and be responsible for their own profit and loss. The second one is the post-Olympic sustainable usage of the Forest Park. After Beijing Olympic Games, this forest park is designed as an urban park and wetland in the urban area. It is important to achieve the balance between keeping natural landscapes and attracting tourists as many as possible, since if a large number of people coming into this forest park every day, it may lose some natural features such as maintaining Beijing biological diversity and gene pool, and improving air and water quality as a natural wetland. Forest Park should also be mix-used.

Chapter 2 Literature Review

This chapter briefly described the basic information of Beijing Olympic stadiums and Olympic Forest Park; stated historical development of Beijing Olympic stadiums and Forest Park after the Games; discussed the current sustainable reuse of Beijing Olympic stadiums and Forest Park.

2.1 Beijing Olympic Stadiums Literature Review

2.1.1 The brief introduction to Beijing Olympic stadiums

Many Beijing Olympic stadiums such as National Stadium (Bird's Nest), and National Swimming Center (Water Cube), were in the Olympic Green in Chaoyang district. The Olympic Green can be divided into three parts including Stadiums Area, Olympic Village, and Forest Park. Some stadiums were located in the Stadiums Area. The Stadiums Area can be divided into two parts. The southern part was Old Stadiums Area. This area was the main stadiums area of the 1990 Beijing Asian Games. Some old stadiums such as Yingdong Swimming Center were located in this Old Stadium Area. Almost all of these old stadiums were built for the 1990 Beijing Asian Games. All of them were upgraded and expanded before the 2008 Beijing Olympic Games. The northern part was New Stadium Area. In this area, the stadiums were newly built for 2008 Beijing Olympics. (Xiaodi Zhu 2013)

In addition, some Olympic stadiums including China Agricultural University Gymnasium and University of Science and Technology Beijing Gymnasium were located in the University Area in Handian district just next to the Olympic Green. Some Olympic

stadiums such as Fengtai Softball Palestrae were located in other districts in Beijing.

During the period of 2008 Beijing Olympic Games, twenty two venues were put into use. Ten of them were totally new. Eight of them were upgraded and expanded. Four of them were temporary. (Xiaodi Zhu 2013) National Stadium (Bird's Nest) was the most prominent structure among these Olympic stadiums. It was designed by Herzog and De Mueron, two architects from Switzerland. The twisted steel outline of National Stadium hasd become an iconic figure in Beijing. (Andrea Blaser 2008)

2.1.2 The importance and difficulties of post-Olympic sustainable usage of Beijing Olympic stadiums

"Olympic venues are not only sport facilities; they stand for national and regional representation and shall show the competence of technology, engineering and architecture of the Olympic Cities." (Natalie Essig 2008) The Olympic and Paralympics Games occupy a short period of six weeks which constitutes just 0.3% of the normal forty year life of a sport facility. Whilst the Olympic Games are the main event with gargantuan spectator numbers every facility, the remaining 99.7% of the facilities' lifetime is important too: it is the legacy period. The sustainable usage of these stadiums after Olympic Games is quite important. However, there are many problems on how to make venues and facilities sustainable reused after mega event still exist. Generally, the problems about how to make venues and facilities sustainable reused after Olympic Games can be put into three main reasons. (Mo Sha 2011)

- The high maintenance costs of Olympic venues.

- Government spent a lot of money building venues, which caused it quite difficult to convert them after the Games.
- Usually the government lacked the experience on the management about post-Olympic sustainable usage of stadiums and facilities.

Almost every host city wanted to host the best ever Olympic Games. They tended to invest a huge number of money and resources building stadiums and facilities. As a result, after Olympic Games, the governments had to afford the high maintenance costs of Olympic venues. In order to save money and resources, some stadiums and facilities had to be abandoned after Olympic Games. For example, LaoShan Velodrome and Beijing Olympic tennis court are nearly abandoned because both of which were closed after Beijing Olympic Games due to the high maintenance costs. (Mo Sha 2011)

In the second reason, if the government invested a lot before the Games to build a huge stadium, it will be hard to make it converted because this stadium is very huge. Moreover, if the local Olympic Committee invested a large number of money on stadiums, it may be uneconomic to convert them. The third reason is that usually the government lacked the experience on the management about post-Olympic sustainable usage of stadiums and facilities. These three reasons are why it is hard to make stadiums sustainable reused after the Olympics. (Mo Sha 2011)

2.1.3 Several modes of the post-Olympic usage of stadiums

From 1984 Los Angeles Olympic Games hosted in the USA, almost every host city gained benefits from the Games. According to Xinhua Express, Chinese government invested

about 42 billion US dollars totally for 2008 Olympics. This investment made this Olympic Games became the most expensive Olympic Games in history. The total investment for 2004 Athens Olympic Games was 15 billion US dollars. Comparing to Beijing huge Olympic bills, Athens Olympic budget is very small and trivial, although every single Athens citizen got into heavy debt for this Olympic budget. Beijing built a lot of stadiums, sports facilities, apartments, and some other infrastructures including roads, metro station, and urban green belts. National Stadium, also called the Bird's Nest by local people, cost government 500 million US dollars. Although Beijing and Chinese government is able to afford such a huge investment, there are still many criticisms about the huge investment amount for this Olympic Games. Some people argued that firstly Beijing government got the money from people all over the country. That's why Beijing can afford 42 billion US dollars investment. However, only the residents living in the city of Beijing or surrounding area can enjoy this Olympic Games and its facilities. This inequity caused taxpayers living in other places a lot of dissatisfaction even when Beijing just got this Olympic Games in 2001. In addition, some critics said that there are many poor people in China. They are unsatisfied that government put such a large number of money on an Olympic Games rather than these poor people. Moreover, some people even suspect that whether the investment amount and net benefit amount provided by Xinhua Express and Olympic Committee official website is accurate or not. They believe government invested more than the published data. Therefore, it is very important to get the stadiums sustainable reused after the Games since sustainable reused stadiums can save a lot of money and resources, which can bring Beijing government more benefits and reduce the nationwide criticism.

Usually after the Olympic Games, the usage of Olympic venues can be divided into four modes. (Mo Sha 2011)

- Continuing organizing sports activities.
- Versatile mode.
- Alternate use.
- The removal of temporary venues.

In the first mode, stadiums will continue hosting sporting events after Beijing Olympic Games. Organizers can make money from the sports event tickets fee and other relevant revenues. For example, from 2011, National Stadium (Bird's Nest) hosted Italian Super Cup every summer. Especially in 2011 summer, AC Milan and Internationale competed for Italian Super Cup in National Stadium. These two world-famous football clubs attracted thousands of foreign football fans from Italy, Japan, Thailand, South Korea, and other countries. Fans filled up 91,000 seats in National Stadium. The organizer got about 16.01 million US dollars from only the tickets fee. According to Sina Express, AC Milan Football Club and Internationale Football Club got 150 million Euros totally from the organizer, which meant that the organizer got much more than 150 million Euros from hosting Italian Super Cup. The money gained from hosting sports events can cover the maintenance fee and make the stadiums better. In the second mode, People can gain benefits through using stadiums to host concerts and exhibitions. For example, after 2008 Beijing Olympics, National Stadium usually hosted three or four big concerts every year. National Stadium makes a lot of money from hosting concerts and exhibitions. The third one is alternate use. Stadiums can be

converted to residential apartments. The fourth one is the removal of temporary venues. Some stadiums without a lot of value should be planned and designed as temporary buildings. After Olympic Games, these temporary stadiums can be removed quickly. These four modes are not used separately. A stadium can host sports activities, concerts, and exhibitions. If a stadium cannot bring benefits to local government, it may be converted to an apartment or even removed. (Mo Sha 2011) Compared to the four traditional reuse mode stated above, Olympic stadiums used for multiple purposes have become more and more popular in recent years. Ground sharing options, and the addition of non-sports events such as concerts or other art performances, can bring stadiums extra revenues. With the appropriate scheduling, an Olympic stadium can host other sports events as well as music or cultural events, rent some rooms out to be hotels, restaurants, offices, convenient stores, host some conferences, build the training center or small parks, and develop real estate in the surrounding areas. Stadiums alone may not be an attractive investment for private or public sponsors. Therefore the potentially higher returns secured from commercial, residential or other traditional land uses, whose revenues may be more predictable and secure, can assist in financing the capital costs associated with the stadium by diluting the risk of the project between the different components. (Von Gerkan Marg, 2013)

In addition, a mix-used stadium can make visitors enjoy broader utilization on non-match days. The hotels, restaurants, and other facilities located inside can occupy the empty space of the stadium. For instance, the food and beverage store in an Olympic stadium can maximize fans and guests' experience and create a more convenient environment. Furthermore, stadiums are being built with mixed-used developments often as part of urban regeneration,

which may benefit the whole surrounding areas.

Moreover, the diverse types of functions in a mix-used stadium can benefit each other. For example, the retail function such as malls located inside a stadium may get benefits from sports function of this stadium because a sports game can easily attract a large number of audience. Retail and sports function can also bring benefits to the hotels as well as restaurants.

The decision to make an Olympic stadium mix-reused after the Games should be made based on a throughout benefit-cost analysis. This analysis should include detailed research into market demand trends and an understanding of competition from the other stadiums. (Von Gerkan Marg, 2013)

2.1.4 The historical development of the post-Olympic usage of Olympic stadiums

In history, quite a lot Olympic host cities found that the stadiums and facilities built for the Olympic Games were a tremendous burden after the Games. During the post-Olympic Games period, many stadiums and facilities which cost the host cities a lot of money and resources before the Games were laid idle or underused. The bad management and regulation loopholes were the usual cause of this situation. Beijing has been given the 29th Olympic Games by IOC (International Olympic committee) since 2001. Then the local government spent seven years and a large number of money and resources preparing this Olympic Games. In the short period of sixteen days, the Beijing Olympic Games ended with the dazzling fireworks, which brought Beijing into post-Olympic Games period. How to make the Olympic venues and facilities sustainable reused after the Games is a complex problem in

front of every city which hosted or will host the Olympic Games.

Munich is located in the south of Germany. It is the capital of Bavaria and the third largest city in Germany. Before 1972 Munich Olympics, it is a city with a lot of museums and theaters but pool sports facilities and infrastructure. Besides, during the period in 1960s, Munich government faced the problems about rapid population growth and regional inequity. The local government decided to build an Olympic park in the underdeveloped northern part of the city in order to promote the development of that area. Munich Olympic Committee invested about 600 million dollars creating an Olympic park including the Olympiastadion, Olympic Village, and an urban park before the Games.

The Olympiastadion designed by a German architect Gunther Behnisch and engineer Frei Otto is a very famous attraction. Many new technologies were used in this revolutionary stadium. Some parts of the top of this building were designed movable in order to help some spectators avoid sunshine and rain. After the Games, the stadiums in this Olympic park were positioned to serve both the local people and visitors. The local residents can do some sports in some stadiums such as Swimming Pool and Skating rink, attend concerts and activities, and relax themselves in the urban park. The following picture shows this Olympic stadium.

Figure 2 Munich Olympic Stadium

Source: www.ahradio.com.cn

The Olympiastadion used as the main stadium during the period of 1972 Munich Olympic Games was considered as a well-reused stadium in Olympic history. (X Ma 2010) This stadium has a capacity of 80,000 people. Munich government invested 44.7 million Deutsche Marks building this stadium. After the Games, this stadium became the home field of FC Bayern Munich Football Club and TSV 1860 Munich Football Club. It hosted 1974 FIFA World Cup final, 1988 European Cup final, and three UEFA Champions League finals. Almost every final game brought Munich a large number of visitors. Since 2005, it is the host of the yearly air and style snowboard event. It hosted 85 German Cup games totally. Tickets and the revenue that comes from tourism brought a lot of benefits to Munich and the surrounding area. After 2006, both FC Bayern Munich Football Club and TSV 1860 Munich Football Club moved to a new stadium Allianz Arena. The Olympiastadion was no longer the home field of these two football team. Furthermore, Olympiastadion is located in the central

area of the Munich Olympiapark. It is a famous attractor in this Olympic park. Each year about 5 million paying tourists travel to this Olympic park for this stadium and other attractors. (X Ma 2010) In addition, the local government encourages investors to rent part of this stadium and buy the advertising boards after the Games. There are also many stores selling souvenirs and accessories to visitors located in and near this stadium.

After the Games, Munich Olympic Swimming Centre hosted some Swimming Championships. Munich Swimming Club, a club consists of some professionals and amateurs, takes this Swimming Centre as its training base. The ordinary citizens also can swim in this stadium. The price is very reasonable. The single ticket price is only 3.9 Euros. The students studying in Munich can get a half-year ticket by only 20 Euros with student discount. People can swim and dive in this stadium. Moreover, kids can also enjoy themselves there. There are some special areas for kids in the Swimming Center.

Montreal is located in Quebec, Canada. As in Munich, before the Games, Montreal didn't have enough venues and facilities for professionals and local residents. Montreal Olympic Committee invested a large number of money building 11 venues for the coming Olympics. The local government spent 1,474 million dollars creating an Olympic park including Olympic Stadium (main stadium), Montreal Tower, Velodrome, Sports Centre, Olympic Indoor Centre, Swimming Pool, an urban park, and Olympic Village. The huge cost and the bad post-Olympic management made this Olympic Games become the biggest money-loser in Olympic history.

1976 Canada Montreal Olympics which cost Montreal government 1.474 billion dollars is considered as one of the biggest money-losers. Olympic Stadium designed by Roger

Taillbert, the main stadium of this Olympic Games, cost 1,014 million dollars because Roger Taillbert used a lot of new technology. The high design standard resulted in the difficult construction and the high cost. In order to prevent construction delay, the RIO (Regie des installations Olympiques) was organized before the Games. This organization also was in charge of the management and operation of Olympic Stadium, Olympic Swimming Pool, Olympic Village, and Olympic park after the Games. RIO rebuilt the Velodrome as a biodome in 1989. (X Ma 2010) However, this organization didn't find any good way to make the main stadium sustainable reused. Undoubtedly, this main stadium is one of the most beautiful architecture in history. The roof of this architect is retractable. Montreal Tower, a leaning tower, is located next to this stadium. The Olympic Swimming Pool and Olympic Velodrome are situated under Montreal Tower. In the beginning, the designer tried to use Montreal Tower to hoist this retractable roof. However, he gave up this idea at length due to the difficult construction and limited budget. The huge roof was soldered together finally. This stadium was not completed in time for the 1976 Olympics. The construction continued for several years after the Games ended. After the Games, the problem is that the local government can hardly get money from this building. The maintenance cost is very high. Especially in winter, government spends millions of dollars to clean the snow on the top of this building every year. In addition, the retractable roof of the Olympic Stadium caused many problems after the Games. There are a lot of snow and rain in Quebec. Snow and rain can easily get into this stadium through the retractable roof. In 1991 and 1999, the roof and beams collapsed couple times dumping ice and snow on some workers, which made this stadium image slip down faster than a rocket. Because the local taxpayers paid a large

number of money maintaining and changing this roof every year, in 2006, RIO decided to use a new, permanent roof replace this roof. What RIO did in 2006 reduced the maintenance fee of this stadium. RIO rented this stadium to some rugby and baseball club as their home field in the post-Olympic period. This stadium also hosted a big concert for Pink Floyd in 1978. Many travelers visit this stadium and Montreal Tower every year. However, this huge stadium is not well-reused at other time. Although the entrance ticket price is 14 dollars per person, it still cannot cover the maintenance fee. This is why this stadium is named "deficit trap". In the eyes of the local people, this Olympic Games lasted for 31 years and ended in 2007 because only in that very year, Montreal taxpayers got their Olympic debt paid off. Similarly, after 1984 Sarajevo Olympic Games in Yugoslavia, the local government didn't have enough money to maintain the stadiums used in the Games. Many stadiums were abandoned after the Games. Then Bosnian War came and the majority of the venues were heavily damaged.

2000 Sydney Olympic Games was praised as "the most successful Olympic Games in history" by Samaranch, the former chairman of the International Olympic Committee. However, after the Games, the reused situation of the stadiums and facilities cannot make people feel optimistic. There were still a lot of stadiums laid idle or even abandoned till now. Some important Olympic stadiums were covered by grass and bush. The Stadium Australia, the main stadium of Sydney Olympics, which has a capacity of 110,000 spectators, only hosted eight events in 2002. Sydney's Aquatic Centre now just hosts carnivals and company meetings for a living. Sydney's Aquatic Center losses approximately three million Australia dollars a year. The Tennis Centre only hosted some dancing balls and concerts after the Games. Many Olympic stadiums were unable to pay the business tax since 2001, some of

which even declared bankruptcy because of the bad management. For example, the Acer Arena which has a capacity of 21,000 spectators declared bankruptcy in 2003 because it lost 10,500,000 Australia dollars during the past years. The average occupancy rate of the hotels and apartments located near Sydney Olympic Park was only approximately 30%. (Zhongmo Han. 2013) Sydney government is still suffering from the post-Olympic Valley Effect till now.

2004 Athens Olympic Games is widely considered as the most expensive Olympic Games since 1980 Moscow Olympic Games after that Olympic Games according to the statistical data of European Union. (Archives of urban construction, 2008) Conservative estimates would say that every single Athens citizens has to bear the burden of debts for this festival during the short period of fifteen days. (Archives of urban construction, 2008) However, "…eight years after the 2004 Athens Games, many of the Olympic venues Greece built at great expense remain abandoned or rarely used. At the southern Athens venue for softball – a sport unknown in Greece and already out of the Summer Olympics – the occasional weed is all that remains on the dried-out field. With no shortage of real beaches in Greece, the purpose-built beach volleyball stadium has seen minimal use in the past eight years, mostly just concerts." (Archives of urban construction, 2008) Some other stadiums were in approximately same bad condition. For example, the hockey venue was nearly abandoned. Materials used in the Games hosted eight years ago still lies around the stadium. Nobody have ever cleaned or maintained this venue. In addition, there were many other problems on Olympic stadiums in 2004 Olympics. For instance, Athens government invested 12 billion dollars building stadiums and facilities, operating Olympic Games, and paying

other spending. Such a large investment resulted in the government's fiscal burden soon. Not only Athens government, but also Greece government faced the fiscal deficit during that period. The majority of the stadiums were not reused properly after the Games. (Zhongmo Han. 2013) The local government didn't make the detailed reuse plan about these stadiums before the Games because it spent a lot of energy preventing stadiums project delay before the Games. After the Games, the local government spent a lot of time and energy solving the problems on ownership of Olympic stadiums. As a result, it didn't focus on the sustainable reuse of these stadiums. The above two aspects are considered as the mainly reasons why the majority of the stadiums were not reused properly after 2004 Athens Olympic Games.

Figure 3 abandoned Athens Olympic stadiums

Source:

http://news.nationalgeographic.com/news/2012/07/pictures/120726-2012-olympics-games-london-sports-venues-world-sports/#/london-olympics-past-venues-athens-tae-kwan-do_57294_600x450.jpg

2.1.5 The current reused situation of the Beijing Olympic stadiums after the Games

After 2008 Beijing Olympic Games, some Olympic stadiums were well utilized. The definition of well-utilization refers to during the period from 2008 till now, these stadiums were not abandoned. Instead, they had chances to host various activities and events. In addition, the local government can get benefits from these stadiums. For example, well-utilized Olympic stadiums include the National Stadium (Bird's Nest), the National Swimming Centre (Water Cube), and National Indoor Stadium and so on. The following table shows the usage of some main venues after Beijing Olympic Games.

Table 1 the usage of some main venues after Beijing Olympic Games

Olympic Venues	During Olympic Games	After Olympic Games
Bird's Nest	Main stadium, undertaking the opening and closing ceremony, and soccer final.	Hosting sporting events, tourism, concerts and exhibitions
National Swimming Centre (Water Cube)	Swimming, diving and Synchronized Swimming	Hosting swimming events, open for citizens
National Indoor Stadium	Artistic gymnastics, trampoline and handball	Communities center for citizens
The Main Press Centre	Media center	Shopping mall, food court.

Source: Xiaodi Zhu. 2013. The Impact of the Reuse of Beijing's Olympic Green to Beijing's Urban Development. World Architecture.

Some Olympic stadiums hosted some sports activities after the Games. Through hosting some big sports events, these Olympic stadiums can avoid being abandoned after the Games. Organizers can get benefits from rental fee and tickets fee. In addition, hosting big sports events can promote local economy by attracting many visitors and sports fans to Beijing. These sports fans can bring new impetus to local tourism. Moreover, hosting world-famous big sports events can improve Chinese athletes' abilities because many famous athletes will

come to Beijing to attend these events. Furthermore, the local residents and students can enjoy these big sports activities hosted in the Olympic stadiums. The following table shows some big sports events hosted by the Olympic stadiums after the Games.

Table 2 some big sports events hosted by the Olympic stadiums after the Games

Time (M/D/Y)	Stadiums Names	Sports Events Names
08/08/2009	National Stadium	2009 Italian Football Super Cup
05/02/2009	Shunyi Olympic Water Park	Bainian Niulanshan Cup Sino-USA Water Skiing Game
06/14/2009	Laoshan Velodrome	2009 National Track Cycling Tournament
09/01/2009	National Swimming Centre	National Swimming Tournament
10/01/2009	Olympic Tennis Centre	China Tennis Open
10/11/2009	Wukesong Stadium	NBA Preseason Game Beijing Station: Nuggets VS Pacers
11/12/2009	National Stadium	2009 the Race of Champion

Source: Xiaodi Zhu. 2013. The Impact of the Reuse of Beijing's Olympic Green to Beijing's Urban Development. World Architecture.

Some stadiums hosted some big commercial performances after the Games. Usually the big commercial performances were hosted by some huge Olympic stadiums such as the National Stadium, National Swimming Centre, and Wukesong Stadium. On the one hand, these huge stadiums are attractions after the Games. The huge architecture and the Olympic background gained from the 2008 Olympics can attract a lot of visitors there. On the other hand, the big commercial performances like concerts and exhibitions can attract visitors and fans from all over the world. Big commercial performances can bring benefits to the local government. The following table shows some big commercial performances hosted by the Olympic stadiums after the Games.

Table 3 commercial performances hosted by the Olympic stadiums after the Games

Time (M/D/Y)	Stadiums Names	Commercial Performance Names
09/30/2008	National Swimming Centre	Magic Water Cube Performance
10/06/2008	Wukesong Stadium	Avril Lavigne Concert
11/29/2008	National Stadium	Charity Performance for the disable
01/03/2009	National Stadium	2009 Lang Lang Beijing New year Concert
05/01/2009	National Stadium	Jackie Chan and his friends Concert
06/01/2009	National Swimming Centre	The Legend of Beijing Dancing Performance
06/26/2009	National Swimming Centre	Swan Lake
08/22/2009	Beijing University of Science and Technology Gym	Fahrenheit and SHE concert
10/06/2009	National Stadium	Turandot Show
10/23/2009	Wukesong Stadium	Beyonce concert
10/24/2009	Beijing University of Science and Technology Gym	Sun Yanzi concert
12/13/2009	Wukesong Stadium	USA Harlem Globetrotters Show
12/26/2009	Wukesong Stadium	Li Yuchun concert

Source: Xiaodi Zhu. 2013. The Impact of the Reuse of Beijing's Olympic Green to Beijing's Urban Development. World Architecture.

Mega events usually can promote the development of local tourism. Firstly, mega events can attract a lot of visitors to host cities in order to attend these mega events. The local government can make a large number of money from these visitors. Second of all, usually before a mega event, host city is supposed to invest money and resources building basic infrastructure. The basic infrastructure and facilities can improve the life standard of local residents and tourism attraction. Last but not the least, the huge architectures such as huge stadiums built for a mega event can be great attractions. After 2008 Beijing Olympics, the

Olympic stadiums used in Beijing Olympics became Beijing's new attractions. In April 2009, Beijing Tourism Organization and C-trip Website organized a poll online in order to elect five attractions which can best represent Beijing's image. The Great Wall Badaling, National Swimming Centre (the Water Cube), the Imperial Palace (the Forbidden City), National Stadium, and Tiananmen Square became the top five attractions which can best represent Beijing's image.

After 2008 Beijing Olympics, Olympic stadiums brought a lot of tourism revenue for Beijing government. For example, National Stadium and National Swimming Centre are open after the Games. The full entrance ticket price of National Stadium is 50 RMB (about 8 US dollars) per person. The full entrance ticket price of National Swimming Centre is 30 RMB (about 4.8 US dollars) per person. During the period from Olympic Games to the end of 2008, there are about 120 thousand tourists visiting National Stadium and National Swimming Centre every week. The Olympic Green can attract about 180 thousand visitors every week. (Rui Chen, Jie Dong 2010) From the beginning of 2009, the local government put some entertainment facilities such as ice rink, amusement park around National Stadium, which can attract more visitors from then on. The Olympic Green and stadiums can bring the local government a large number of tourism revenue every year.

Besides, some stadiums are used as training halls for professionals or National Team and fitness halls for residents and students living and studying in local area. For example, Beijing Shooting Range Hall and Laoshan Velodrome are used as training halls for professional players. Usually ordinary citizens in China are not good at and interested in shooting and track cycling because shooting and track cycling are very hard and expensive for ordinary

residents. As a result, after the Games, almost no one used these two stadiums except National Teams. For some other stadiums, especially the stadiums located in the university district, many residents and students used these stadiums after the Games. The following table shows the stadiums open as fitness halls for residents and students living and studying in local area.

Table 4 the stadiums open as fitness halls for residents and students living and studying in local area

Stadiums Names	Program	Price Per Hour
Beijing University of Science and Technology Gym	Badminton	60 RMB (9.6 US Dollars)
China Agricultural University Gym	Badminton	15 RMB (2.4 US Dollars)
Beijing University of Technology	Badminton	70 RMB (11.2 US Dollars)
National Swimming Center	Swimming	50 RMB (8 US Dollars)

Source: Xiaodi Zhu. 2013. The Impact of the Reuse of Beijing's Olympic Green to Beijing's Urban Development. World Architecture.

These stadiums open as fitness halls for residents and students living and studying in local area not only help the local government gain benefits from the entrance fee, but also provide local residents and students very good fitness halls.

However, some stadiums were poor utilized. Most of them were abandoned or only hosted one or two events after the Games during the period from 2008 till now. Such stadiums include Beijing Olympic tennis court and so on. For example, after 2008 Beijing Olympics, only China National Team used Laoshan Velodrome couple times. Local residents and students didn't use this track cycling stadium at all. Since at the beginning, Laoshan Velodrome was designed as professional standard. The slope is very steep. Ordinary people cannot ride in this stadium. As a result, after the Games, this stadium has lain idle most of the

time. Beijing Olympic tennis court has also lain idle after the Olympics. Tennis is considered as a “noble sport” in China. Not many people played tennis in this Olympic tennis court. The local government cannot get money from these stadiums to cover the maintenance fee. In addition, Rubber Dinghy Stadium, Olympic Beach Volleyball Court, and Olympic Baseball Field faced the same dilemma after the Games. The following picture shows the abandoned Olympic Beach Volleyball Court.

Figure 4 abandoned Beijing Olympic stadiums

Source:
http://news.nationalgeographic.com/news/2012/07/pictures/120726-2012-olympics-games-london-sports-venues-world-sports/#/london-olympics-past-venues-beijing-bmx_57295_600x450.jpg

2.2 Beijing Forest Park Literature Review

2.2.1 The brief introduction to Beijing Forest Park

Forest park, also called Beijing’s Olympic Forest Park, is located at the north end of the Olympic Green. It is a large, man-made nature park at the north end of Beijing’s central axis. It covers an area of seven square kilometers. (Hu Jie Dong Li 2006) The north side of the

lake has a mountain that gives an excellent view of this part of the city. Nowadays, forest park consists of 14 historical sites and cultural relics including 11 historical tombstones, 2 stone inscriptions, and one Dragon King Temple. It has a large area of green land and wetland. Woodland and forests cover an area of 405 hectares. Lakes and wetland cover an area of 26 hectares. (Shengdong Ye 2008) The landscape architecture design was led by Hu Jie, director of the Landscape Planning and Design Institute at the Urban Planning and Design Institute of Tsinghua University. Hu Jie designed and created an "Axis of Nature" in order to express the Chinese traditional beauty. "In accordance with traditional Feng Shui practice, this involved a hill at the north and a lake to the south. The hills, woods and water concept are however along the lines of China's imperial parks – and are very appropriate to Beijing's climate."[1] The Forest Park was designed to accommodate tennis, archery and hockey events during the 2008 Olympic Games and a great public park, in which only electric vehicles are allowed, after the Games. An expressway which crosses the park has been designed as a "green bridge" ecological corridor over Beijing's Fifth Ring Road. It links the southern and northern parts of the forest park and is intended to be a landmark. The Olympic Forest Park has subway stations, an open air theatre, a lake, and a sophisticated system for bubbling air into the water for purification.

[1] gardenvisit.com

Figure 5 the location of Olympic Forest Park

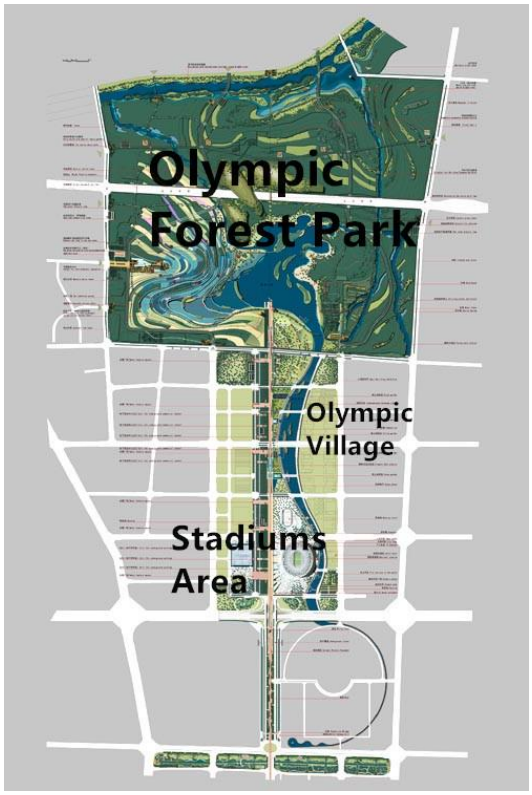
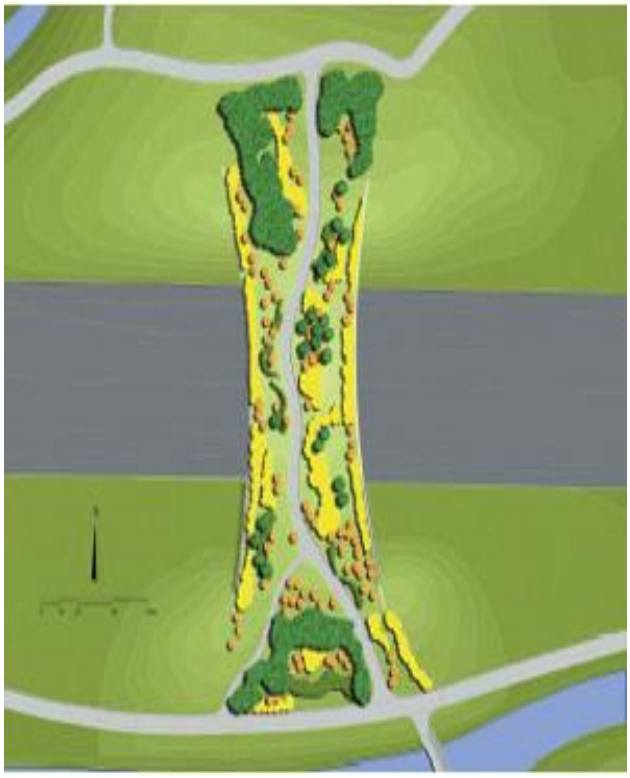


Figure 6 the "Green Bridge" in the Forest Park



Source: http://www.gardenvisit.com/garden/olympic_forest_park_beijing

2.2.2 The benefits bought by Olympic Forest Park

Beijing's Olympic Forest Park can bring a lot of benefits to the residents living in the Great Beijing area. As one of the largest public parks Beijing's urban area, Forest Park can be a "green lung" of the Great Beijing area to absorb the dirt and exhausts and release the fresh air, which means a lot to Beijing's government because today's Beijing citizens suffered from haze and sand storms. Besides, Beijing's Forest Park can preserve local ecosystem and biodiversity. The hills, woods and wetlands in Forest Park are supposed to provide a habitat for the creatures in the local areas. Furthermore, Forest Park can have a positive effect on the "heat island effect" in Beijing's urban area.

Forest Park can also provide an open space for the residents and students living, working,

and studying in the surrounding areas. As Frederick Olmsted once mentioned in his articles, “It is under similar conditions to these that we find in nature that class of scenery…which is termed pastoral. It consists of combinations of trees, standing singly or in groups, and casting their shadows over broad stretches of turf, or repeating their beauty by reflection upon the calm surface of pools, and the predominant associations are in the highest degree tranquilizing and grateful, as expressed by the Hebrew poet: 'He maketh me to lie down in green pastures; he leadeth me beside the still waters.’.” (Frederick Olmsted 1870) “It is one of the great purposes of the Park to supply to the hundreds of thousands of tired workers, who have no opportunity to spend their summers in the country, a specimen of God’s handiwork that shall be to them, inexpensively, what a month or two in the White Mountains or the Adirondacks is, at great cost, to those in easier circumstances.” (Frederick Olmsted 1870) Not only for the tired workers, but also for the local residents, students, and tourists, an open urban park is a great open space for them to have fun, relax themselves, and do some social activities.

Figure 7 Bird's view of Beijing Olympic Forest Park

Source: http://www.drawingontheland.com/?p=2792

Frederick Olmsted also mentioned that an urban park can keep the urban area healthful and sanitary. "The Country magnet declares herself to be the source of all beauty and wealth. But the Town magnet mockingly reminds her that she is very dull for lack of society, and very sparing of her gifts for lack of capital." (Ebenezer Howard 1902) The forest parks in the urban area can have the magnetism of both country and town because they are beautiful and social. As a result, it is very important to keep the Forest Park in good maintenance and operation after the Games. If Forest Park is used through a sustainable way after the Games, it can benefit the people in the Great Beijing Area for a long time.

Urban Forest Park can also provide economic benefits for both municipalities as well as citizens. (Anna Chiesura 2004) For example, air purification caused by tree planting can result in reduced costs of pollution reduction and prevention measures. (Tagtow, 1990) In

addition, urban park can create a better urban environment, which can improve local residents' health. Better health can bring economic benefits. Furthermore, the historical and recreational values of urban parks can attract tourists and increase city's attractiveness. (Tagtow, 1990) Moreover, natural elements such as trees or water increase property values, and therefore tax revenues as well. (Luttik, 2000)

Forest Park is not only an open space. It has a large area of hills, forests and wetlands. It is more attractive than the ordinary urban park. It is a great place for the forest recreation. Forest recreation is "… the recreation involving direct contact with forests in various activities ranging from walking in the woods to wilderness backpacking." (Shengdong Ye 2008) For the ordinary forest parks, they can not only purify air, contain water and soil, and keep biodiversity, but also can attract visitors to accelerate the development of the local economy, and raise their awareness about the environment by carrying out various forest tourism activities. Forests are important tourism attractions in the forest park. Many local creatures can live in the forest park. Visitors can be pleased and educated by viewing how beautiful and significant the various wild animals and plants are in the forest park.

2.2.3 The historical development of the post-Olympic usage of Olympic Forest Park

Putting a large, man-made public park near the stadiums and Olympic Village and in the urban area is ingeniously idea and design. In 1972 Munich Olympic Games, the Munich government established the Olympiapark which consists of the Olympic Area including many stadiums and sports facilities, Olympic Village, Olympic Media City, and Olympic Park. Just as the Forest Park in Beijing's Olympic Green, The Olympic Park is an open public park in

Munich Olympiapark. It "… adjoined the Olympic Area to the south, including the Olympic Mountain and Olympic Lake." (Gregg W. Throckmorton 1986) "It is a remarkable modern landscape. … previously, the site was dull and flat, surrounded with ugly buildings and strewn with heaps of rubble cleared from the 1945 bombing of Munich. It was transformed into a sinuous web of tented structures."[2] After the Games, "the Park continues to serve as a venue for cultural, social, and religious events such as events of worship."[3] Besides, because it is very convenient for people living in Munich to go to the Park by public transportation, it became a very famous tourism attraction and a perfect open space for local residents to have fun and relax themselves.

In 2004 Athens Olympic Games, Athens government also used Temple of Olympia as a park. Temple of Olympia is a holly place for ancient Olympic Games. In 2004, some rites were held in this relic of ancient Doric columns. There is no town near this park. After the Games, this park was used as a tourism attraction in part because the 2004 Olympic Games made Temple of Olympia more famous and attractive towards people from all over the world.

In 2012 London Olympic Games, London government also designed and created an open public park for the athletes and the local residents. During the period of the Games, there were some stadiums and facilities in the park for the sports events and activities. After the Games, this open park was redesigned to become the Queen Elizabeth Olympic Park. Many infrastructures and facilities were moved or redesigned. The whole parts of the Park will open in 2014. It will be a public park which is "… beautiful, well managed and with lots to do." (Andrew Harland 2013) This urban park will be a good leisurely place for both local people

[2] gardenvisit.com
[3] http://www.olympiapark.de/

and tourists.

2.2.4 The sustainable usage of Beijing Olympic Forest Park after the Games

For the Beijing's Olympic Forest Park, it was built to make the athletes and officials living in Olympic Village during the Olympic Games feel more comfortable. Many Olympic events were held in this Forest Park. As a result, it is a forest park with a strong Olympic background. This background can make this forest park much more attractive.

With the development of urbanization, more and more people suffer from the urban problems such as noisy, pollution and the crowded. They want to go back to the natural environment. They want to go to forest parks to enjoy peacefulness and natural beauty. Compared to the Temple of Olympia in Athens, Beijing Olympic Forest Park is located in urban area. Residents can easily walk, drive, or take public transportation to this forest park. They will not feel tired before they arrive at Forest Park because they don't waste long time on the way. Beijing Forest Park's Olympic background and Chinese traditional Beauty such as "Axis of Nature" and Feng Shui practice can attract more people. These advantages of Beijing's Olympic Forest Park should be utilized by Beijing government.

After the Games, it is very important to keep the Forest Park in good maintenance and operation. As a result, Forest Park should be designed and developed in a sustainable way. Since Forest Park can attract a lot of visitors, if these visitors destroy the natural environments in Forest Park, the Park cannot serve Beijing and local residents anymore. During the period of development, the Park should avoid the several following problems (Shengdong Ye 2008):

(1). Ignoring the market demands. The local government should avoid ignoring the market demands and developing Forest Park without any market research. If it invested a large number of money to redesign and rebuild Forest Park after the Games but cannot make enough money from the Park because it cannot attract enough visitors. The Park may be abandoned over time. Without the good maintenance, the natural resources may be destroyed at length.

(2). Making Forest Park over-developed and blindly used. The local government should avoid over-developing Forest Park, for example, letting a large number of visitors in without any arrangement for a long time. A lot of visitors may destroy the Park because the local government doesn't consider the environmental bearing capacity of Forest Park. The forests and natural resource may also be destroyed finally.

Chapter 3 Data and Methodology

This chapter described the main data and methodology used in this thesis, such as sources of secondary data, survey and interview to collect first-hand data, and data analysis to test my hypothesis and answer the researchable questions.

3.1 Overview

This thesis investigated the sustainable usage of the Olympic stadiums, facilities, and Forest Park built for 2008 Beijing Olympic Games. I relied on the following sources for data collection. First of all, I collected related secondary data from the current reuse situation and previous Olympic Games experiences gained from the literature review. Second, I used survey, interviews, and some other methods for primary data on the sustainable reuse of Beijing Olympic stadiums and Forest Park.

The goals-based evaluation was to analyze whether the current reused situation after the Games meet the sustainable goals, and whether what Beijing government did after the Games meet the sustainable goals. The typical types of qualitative research included interviews, surveys, participant observation, focus group, and charrettes. For this thesis, I conducted surveys and interviews in the Olympic Green, surrounding areas, and other places where Olympic stadiums were located. During my field trip, I visited all the stadiums located in city of Beijing. I conducted surveys with both local residents and visitors. I also did interviews with government officials, local residents, visitors, and some experts experienced in sustainable development and Beijing Olympic Games. I also did some participants observations and took pictures in the Olympic Green, surrounding areas, and other places

where Olympic stadiums were located.

After data collection, I used quantitative research methods. The quantitative tools for data analysis generally borrowed from the physical sciences, in that they were structured in such a way so as to guarantee, objectivity, generalizability and reliability (Creswell, 2003). The types of the quantitative research methods included descriptive, correlational, cause-comparative, and experimental. I used SEI (Social Equitable Index) to measure the post-Olympic usage of Beijing Olympic stadiums. The range of SEI was from 0 to 1. The larger the index number of one stadium was, the more sustainable this stadium was in social equitable dimension. I will discuss the detailed calculation process in my Finding and Discuss Chapter.

3.2 Survey and Interview

The purposes of this survey was investigating the residents' attitude, perceptions, and actual behavior in order to find whether the Olympic stadiums, facilities, and the Olympic Forest Park were sustainable reused after the Games or not. Post-Olympic sustainable reuse includes three Es: economic, environment, and social equity. This survey focused on environmental and social equitable aspects. I conducted the survey during my field trip of this study, which was from August 1st to August 5th in 2014 in Beijing, China. A convenient sampling procedure was adopted and participation in this study was completely voluntary.

The participants of this thesis consisted of survey residents, visitors, and experts who were experienced in sustainable development and Beijing Olympic Games. The participants answered the questions about how they feel about the environment after the Olympic

facilities was put into use and whether they used the stadiums and facilities frequently or not.

3.2.1 Chosen of Survey Participants

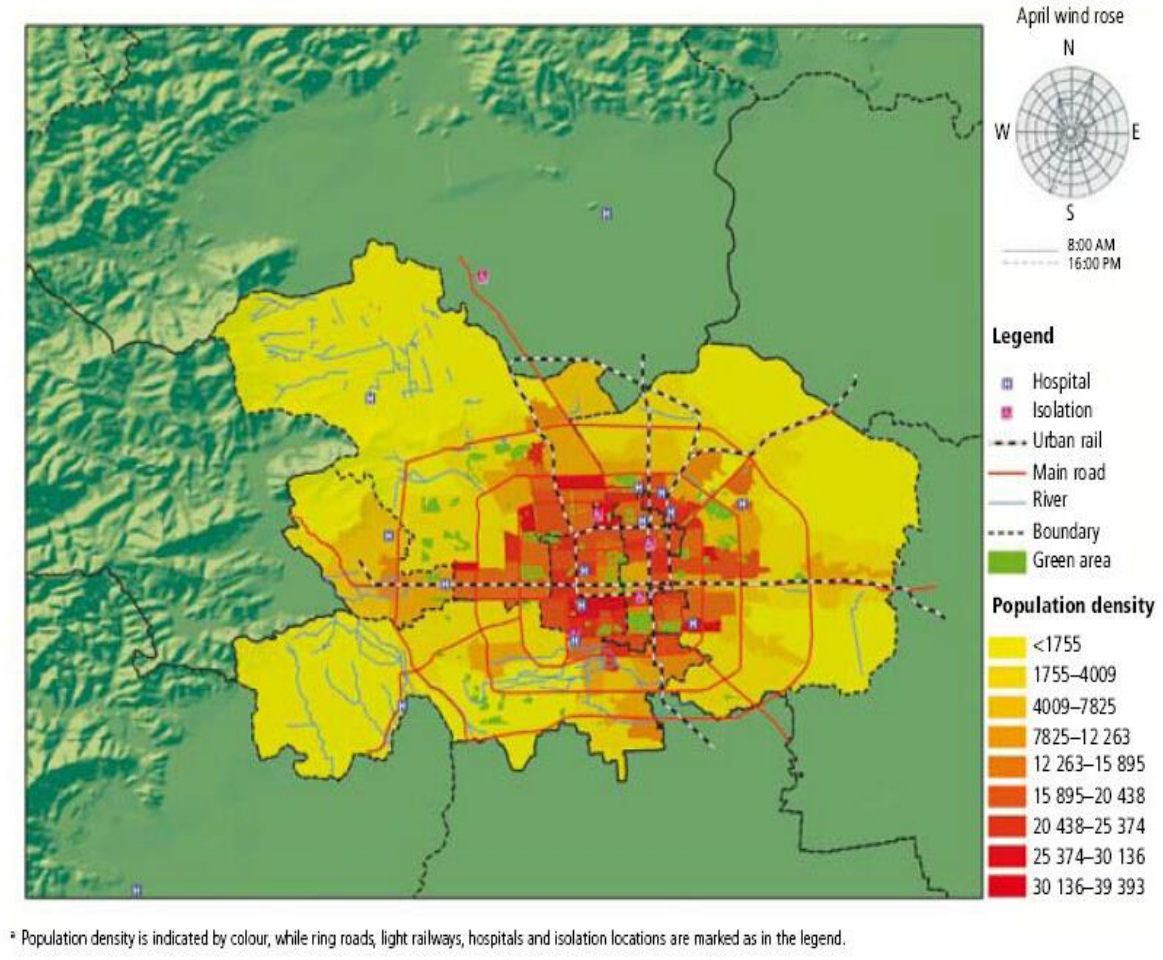
Survey residents and visitors were chosen from the permanent citizens and visitors living and traveling in the city of Beijing by population percentage and Olympic facilities' location. Survey residents were the local citizens living in the city of Beijing who participated in the survey. Beijing can be divided into fourteen districts and two counties now.

Figure 8 Beijing districts and counties

Source: http://s1257.photobucket.com/user/Kyoao/media/BeijingMap.jpg.html

Above figure showed the fourteen districts and two counties in Beijing. Usually, the local residents named Dongcheng district, Xicheng district, Chongwen district, and Xuanwu district as “Beijing Sijiucheng (si is four, jiu is nine, and cheng means city)” which means there were four long walls and nine great gates surrounding these four districts. These four districts were the historical old town of Beijing. In 2010, Chongwen district and Xuanwu district were withdrawn into Dongcheng district and Xicheng district respectively. The urban area of Beijing now included the old town, Handian district, Chaoyang district, Fengtai district, and Shijingshan district. The majority of Beijing’s population lived in these six districts. The rest eight districts and two counties belonged to the suburban area of Beijing. The following figure shows the population density of Beijing’s 14 districts and 2 counties.

Figure 9 The Population Density of Beijing's 16 districts

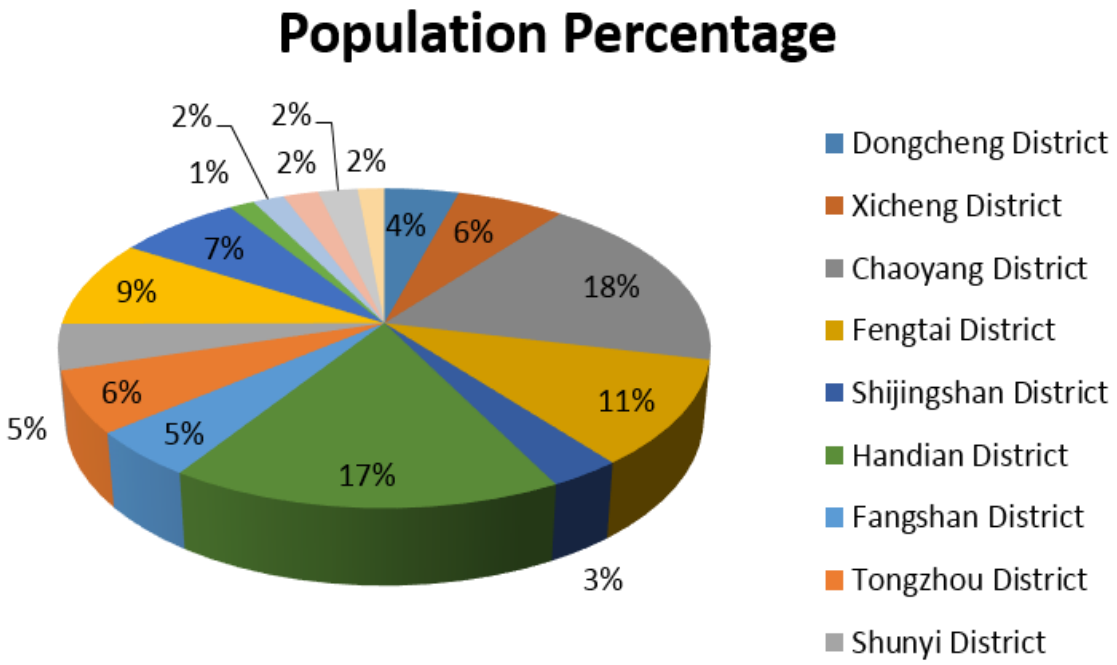


* Population density is indicated by colour, while ring roads, light railways, hospitals and isolation locations are marked as in the legend.

Source: http://www.scielosp.org/img/revistas/bwho/v84n12/a12fig01.jpg

In order to obtain comprehensive sample, survey residents was chosen from the permanent citizens living in city of Beijing by the population percentage. According to 2013 Beijing Statistical Yearbook, the permanent population totally in Beijing was 20.963 million. About 10.52% residents live in the old town including Dongcheng District and Xicheng district. About 18.09% residents live in Chayang District. About 10.69% residents live in Fengtai District. About 16.84% residents live in Handian District. From the following figure, people can find that the majority of permanent citizens live in Chaoyang district, Handian district, and the old town. The following figure shows the percentage of permanent population in each district.

Figure 10 the percentage of permanent population in each district Beijing, China, 2013



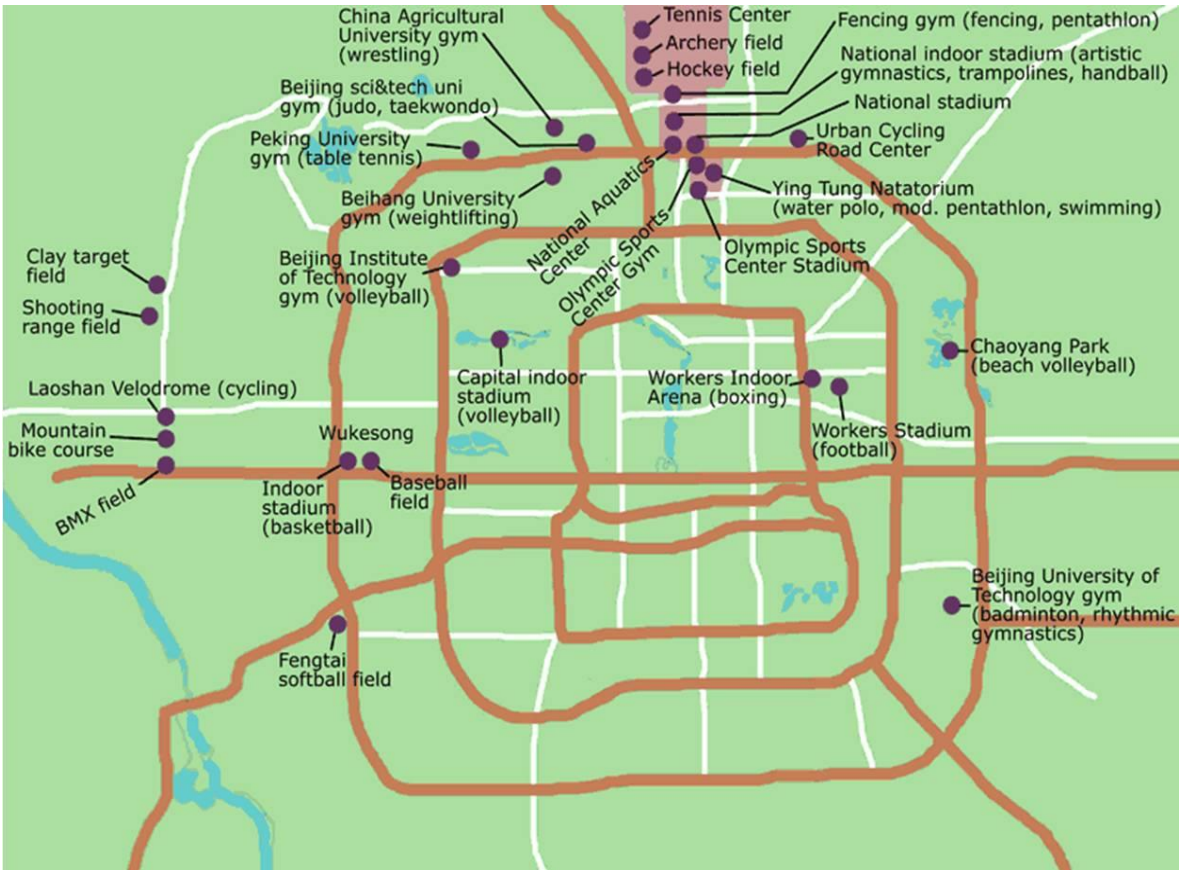
Source: Beijing Statistical Yearbook-2013 Population and Employment 3-3 Total Number of Permanent Population

Survey participants was also chosen from the visitors traveling to the city of Beijing by the population percentage. According to 2013 Beijing Statistical Yearbook, there are 136,202,000 person-times totally from all parts of the country traveling to Beijing in 2013. There are 5,009,000 person-times from all over the world traveling to Beijing in 2013. Participants included both domestic travelers and international travelers, around 96.4% of whom coming from domestic areas and 3.5% coming from overseas. The visitors brought Beijing about 5.1 billion US dollars tourism revenue during the past year. About half surveys were done among the visitors in order to find how they feel about the environment after the Olympic facilities was put into use and whether they used the stadiums and facilities frequently or not. Some visitors who visit Beijing frequently during these years are acquaintance of the authors. The surveys were done by email, online and face-to-face. Some visitors didn't finish all the survey questions during the field trip in Beijing because of the

time limit. Usually they answered some important questions chosen from the survey to express their feelings towards the usage of the Olympic stadiums, facilities, and the Forest Park when the author faced such a situation. The most visitors were in the old town, Chaoyang district, and Handian district since the most tourism attractions were located in these four districts.

Participants were chosen from the permanent citizens of Beijing and visitors by Olympic facilities' location. During the period of 2008 Beijing Olympic Games, the majority of the competition events were host in Beijing. Beijing Olympic Green including stadiums area, Olympic Village, and Forest Park hosted most competition events. The stadiums in the Olympic Green include Olympic Tennis Centre, Olympic Archery Field, Olympic Hockey Field, Yingdong Swimming Centre, National Stadium (Bird's Nest), National Swimming Centre (Water Cube), and National Convention Center. All the above stadiums in the Olympic Green, Beijing Workers' Stadium, Chaoyang Park Beach Volleyball Ground, and Beijing University of Technology Gymnasium are located in Chaoyang district, making the district the most important location for the Olympic facility. Haidian district has the second largest number of the Olympic facilities, such as China Agricultural University Gymnasium, University of Science and Technology Beijing Gymnasium, and so on. From the following figure, people can find the most stadiums and facilities are located in Chaoyang district and Handian district. The following figure shows the locations of all the stadiums in Beijing.

Figure 11 the locations of all the stadiums in Beijing



Source: http://www.mappery.com/maps/Beijing-Olympic-Venues-Map.jpg

As a result, survey residents including permanent residents and visitors were mainly chosen from Chaoyang district and Handian district in Beijing because these two districts had more population and more Olympic stadiums and facilities. Districts with more population got more surveys interviews. Besides, since the majority of the Olympic stadiums are located in Chanyang district and Handian district, more participants living and traveling to Chaoyang district and Handian district are chosen to take part in interviews and surveys. About 104 residents and visitors were chosen in the city of Beijing to finish the survey. About 40 participants living and traveling in Chaoyang district took part in interviews and surveys during the field trip. 43 participants living and traveling in Handian district took part in. Meanwhile, 13 participants are from Xicheng district and Dongcheng district. 3 participants are from Changping district. 3 participants are from Shunyi district. 2 participants are from

Fengtai district. Survey were done by email, telephone, online, and face-to-face. All the participants were voluntary and some of who got some souvenirs after the survey.

3.2.2 Survey Instruments

The questionnaires adopted in the research were made based on the researchable questions and literature review. The questionnaires included the following sections: (a) interviewees' basic backgrounds, (b) interviewees' attitude towards the Olympic facilities, and (c) interviewees' behavior impacted by the Olympic facilities.

In the first section, there were eight questions in choice and single textbox format on interviewees' basic background including gender, age, marriage situation, education, approximate household income, occupation, family size, and location. Then the approximate distance from interviewees' home to the Olympic Green can be calculated when their locations were known. The survey table was listed in the appendix part of this thesis.

In the second section, there were fourteen questions on interviewees' attitude towards the Olympic Green. In this section, interviewees could use number 1 to 5 to express their attitude towards the Olympic facilities. 1 represents Strongly Disagree. 2 is Disagree. 3 is neither Disagree nor Agree. 4 is Agree. 5 is Strongly Agree. In this section, the questions focused on environmental aspect. The questions included air quality, water environment, and industrial pollution. The survey table was listed in the appendix part of this thesis.

In the third section, there were eleven questions in textbox, 1 to 5 scaled and open-ended formats on interviewees' behavior impacted by the Olympic facilities. In this section, the questions focused on social equitable aspect. Interviewees could also use number 1 to 5 to

show their viewpoints. The survey table was listed in the appendix part of this thesis.

All surveys were outsourced to the companies which did their business about distributing leaflets and questionnaires to local residents and travelers. The price was 150 RMB (about 25 US dollars) per person. The money recruiting companies came from the fund obtained from Michigan State University. The results of this survey were very important evidence on whether the Olympic stadiums, Olympic facilities, and the Olympic Forest Park in Beijing were environmental and social equitable reused after the Games or not.

3.2.3 Experts Interviews and Participant Observation

Experts include the professors experienced in planning, sports management, and post-Olympic usage in the universities in Beijing. Some interviews were taken with these professors teaching and living in Beijing. These interviews focused on economical aspect. From the interviews, people could find which stadiums and facilities were economical reused after the Games and whether the Olympic stadiums, Olympic facilities, and the Olympic Forest Park in Beijing obtained the economic benefits after the Games or not. All the interviews were recorded by the telephone and social apps.

Besides, the author also did some participants observation in Beijing and the surrounding areas. The author took some photos as well as notes in and around the stadiums.

3.3 Data Analysis

All the collected data were evaluated and analyzed after the field trip. The four main sources (surveys, author's observations, experts' opinions, and statistics) are examined and evaluated in the thesis.

The survey can be divided into social equity part and environmental part mainly. Through analyzing the social equity part of the survey, the author aimed to understand the basic background of the survey participants. The participants' gender, age, income, occupation, education, and house location may have influenced their opinion and behaviors towards the usage of Olympic stadiums and facilities. Through analyzing the environmental part of the survey, the author aimed to reveal the local residents' and visitors' attitudes and behaviors on whether the Olympic stadiums, facilities, and the Forest Park are sustainable reused in environmental aspect after the Games or not.

For analyzing the environmental aspect, the author is going to rely on the data provided by the environmental part of the survey. Around fourteen questions are about environmental aspect in the questionnaire. Questions on environmental aspect are single-choice questions to ask participants whether they are satisfied with the environment of Beijing during the period before the Olympic Games and current environment including air quality, water environment and so on. Participants could use number 1 to 5 to express their attitude towards the stadiums and the Olympic Green. 1 represents Strongly Disagree. 2 is Disagree. 3 is neither Disagree nor Agree. 4 is Agree. 5 is Strongly Agree. The author will count how many participants chose 1, how many chose 2, how many chose 3, how many chose 4, and how many chose 5. The most frequently chosen option was highlighted in the table. The highlighted option meant the most people's attitudes towards usage of the stadiums and the Olympic Green. If over 50% participants chose one option. It meant this option can represent the majorities' attitudes and it is convincing. If over 50% participants said they were satisfied with the environment of Beijing during the period before the Olympic Games. It indicated that the public believed the

environment in Beijing before the Games was good. If over 50% participants said they were not satisfied with the environment of Beijing during the period before the Olympic Games. It indicated that the public had complaint about the environment in Beijing before the Games. If most people chose they were not clear, it implied that people didn't pay the attention to the environment of the city they are living in. The local government may lack public participation in environmental aspect. If over 50% participants chose they were satisfied with the environment after the Games. It may indicate that the stadiums and the Forest Park improved the environment, at least didn't result in pollution. If over 50% people said that they were not satisfied with the environment after the Games. It may imply that the stadiums and the Forest Park didn't reduce the environmental problems in Beijing after the Games, which means the stadiums and the Forest Park may not be sustainable reused in environmental dimension after the Games.

For analyzing social equity aspect, the author is going to rely on the data offered by the social equitable part of the survey. The questionnaire includes nineteen questions which pay attention to the social equitable aspect in single-choice questions, textboxes, 1 to 5 scaled questions and open-ended formats on participants' behaviors impacted by the stadiums, facilities, and the Olympic Green. Participants can describe their attitudes and behaviors in the textboxes. The answers can be the useful data to reflect the public's attitudes towards the stadiums and the Olympic Green. Participants can use 1 to 5 to describe the whether they visit the stadiums and the Olympic Green frequently or not. Participants were asked how often they visit the stadiums and the Olympic Green in the questionnaire, with numbers ranging from "never" (1) to "every day" (5). If the majority of the people chose they didn't

often go to the stadiums and the Olympic Green. That may imply the stadiums and the Olympic Green are not sustainable reused after the Games in social equitable aspect since the most local residents didn't enjoy the stadiums, facilities, and the forest park. A variety of reasons may lead to this situation. In order to find the reasons why the stadiums and the Olympic Green didn't serve the local residents well, the planning and positioning of the stadiums and the Olympic Green, tickets prices, and the transportation problems are supposed to be considered. If the majority of participants answered they go to the stadiums and the Olympic Green frequently. It indicates that the stadiums and facilities were sustainable reused in social equitable aspect after the Games.

In addition, the results of the questionnaire may be very subjective and can be misleading since this reflects the impression of the general public and they may not know the situation well. As a result, in order to make the results more objective, it is necessary to use another indicators including the author's observation in Beijing during the period of field trip, the interviews taken with the professors and experts experienced in Beijing Olympic Games and sustainable development, and statistics in the income and outcome of stadiums and facilities.

Author's observation can provide a large number of first-hand and second-hand data during the period of field trip in Beijing. The author's observation includes what he saw, his feelings about the current reused situation, the words of people who had talks and interviews with the author in Beijing, and some photos. Since the author visited almost all the Olympic stadiums and facilities in Beijing, what the author saw and his feelings can represent his opinion towards the current reused situation of Olympic stadiums and facilities. Additionally, the words of people who had talks and interviews with the author can reflect the opinions of

people visiting these stadiums. If over 50% people said they are satisfied with the current reused situation such as the entrance price and the service inside, it can imply that these stadiums and facilities did good to serve residents and visitors after the Games. Moreover, the particular interviewee's opinion can represent his or her particular situation, which is also supposed to be taken into account. The photos taken in Beijing can be the evidences in this thesis.

The opinions of experts and professors are analyzed in the thesis. The data provided by the professors working in the universities in Beijing is very important since the majority of who are experienced in mega event and sports management. These opinions can reflect the opinions of elite class in Beijing. Their opinions have the power to influence the usage of Beijing Olympic stadiums. Collecting and analyzing their opinions can help people understand how the current reused situation is formed after the Games. Besides, some experts' opinions towards the current reused situation of Olympic stadiums are very important. Whether the experts are satisfied with the current reuse or not, it is also a criteria to decide whether the current reuse is good or not.

The statistics in the income of stadiums and facilities are listed in the table in the thesis. If the income is larger than the annual spending. That implies that the stadium or facility is sustainable in economic dimension. If the income is not greater than the annual spend. It means that this stadium or facility has something to improve in economic aspect. The sustainable reuse of a stadium or facility is supposed to be divided into economic, social equatible, and environmental dimensions. If a stadium is bad in sustainable aspect, it doesn't mean that this stadium is unsustainable used after the Games. All three Es of sustainability

should be considered. In the meantime, the positioning and planning of stadiums and facilities are also supposed to be considered in the thesis. Whether the stadiums and facilities can make money or cause the fiscal burden of local government, whether local residents and visitors can enjoy the Olympic stadiums and facilities after the Games or not, and whether the stadiums and facilities are reused environmentally or abandoned and caused environment and space wasted, are three main criteria to evaluate whether the current positioning and planning of the stadiums and facilities are good or not.

Chapter 4 Study Area

4.1 Study Area for Beijing Olympic stadiums

This part described the location and basic information of Beijing Olympic stadiums, stated the transportation situations of these stadiums.

4.1.1 The location and basic information of Beijing Olympic stadiums

The majority of the Olympic stadiums for 2008 Beijing Olympics were located in Chaoyang and Handian district in Beijing. During the period of 2008 Beijing Olympic Games, the most competition events were host in Beijing. Shanghai, Tianjin, Qinhuangdao, Shenyang, and Hong Kong hosted some soccer games and equestrian games during the period of the Games.

There were ten stadiums located in Chaoyang district. Seven of these stadiums were located in the Beijing Olympic Green including National Stadium (Bird's Nest), National Swimming Centre (Water Cube) and so on. Seven stadiums were located in Handian district. Six of these seven stadiums were located in the University Area which were close to the Olympic Green including China Agricultural University Gymnasium, University of Science and Technology Beijing Gymnasium, and so on. In addition, five stadiums were located in other district in Beijing.

Ten stadiums were new stadiums built for 2008 Beijing Olympics. Most new stadiums were located in the Olympic Green which was a Olympic park including Stadiums Area, Olympic Village, and Olympic Forest Park for 2008 Beijing Olympic Games. Eight stadiums

were renovated stadiums. Four stadiums were temporary stadiums. The following table showed the location and basic information of each Olympic stadium.

Table 5 the location and basic information of each Olympic stadium

Stadium's Name	Basic Information	Location
Olympic Tennis Centre	New stadium	Chaoyang district
Olympic Archery Field	Temporary stadium	Chaoyang district
Olympic Hockey Field	Temporary stadium	Chaoyang district
Yingdong Swimming Center	Renovated stadium	Chaoyang district
National Stadium (Bird's Nest)	New stadium	Chaoyang district
National Swimming Centre (Water Cube)	New stadium	Chaoyang district
National Indoor Stadium	New stadium	Chaoyang district
Beijing Workers' Stadium	Renovated stadium	Chaoyang district
Chaoyang Park Beach Volleyball Ground	Temporary stadium	Chaoyang district
Beijing University of Technology Gymnasium	New stadium	Chaoyang district
China Agricultural University Gymnasium	New stadium	Handian district
University of Science and Technology Beijing Gymnasium	New stadium	Handian district
Beijing University of Aeronautics and Astronautics stadium	Renovated stadium	Handian district
Peking University Gymnasium	New stadium	Handian district
Beijing Institute of Technology Gymnasium	Renovated stadium	Handian district
Capital Gymnasium	Renovated stadium	Handian district

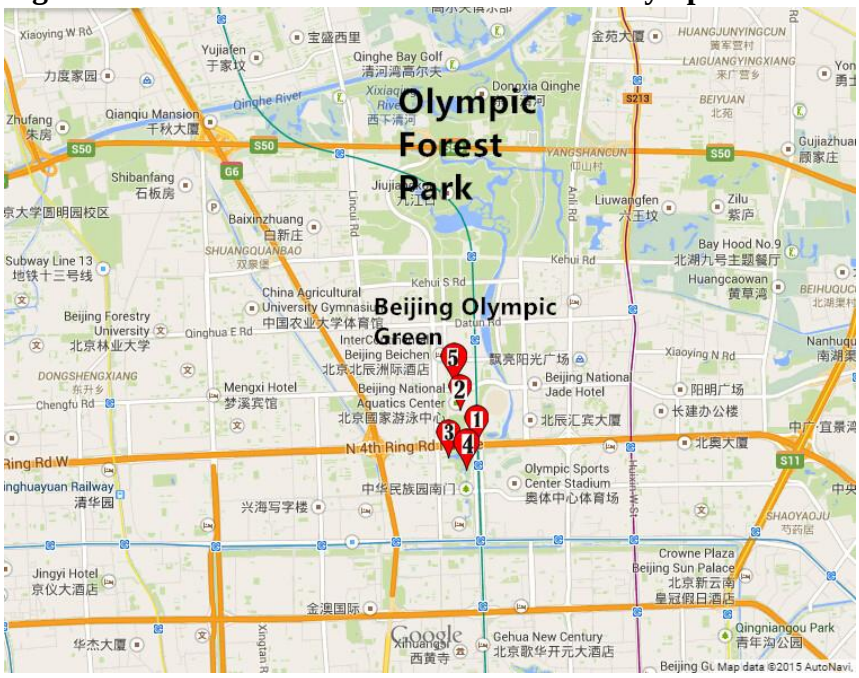
Table 5 (cont'd)

Wukesong Stadium	New stadium	Handian district
Fengtai Softball Palestrae	Renovated stadium	Fengtai district
Shunyi Olympic Water Park	New stadium	Shunyi district
Triathlon Venue	Temporary stadium	Changping district
Laoshan Velodrome	Renovated stadium	Shijingshan district
Beijing Shooting Range CTF	Renovated stadium	Shijingshan district

4.1.2 Transportation situations of Beijing Olympic stadiums

After the Games, all the temporary stadiums were removed. Eighteen new and renovated sports stadiums were planned to be used after the Olympics.

Figure 12 the location of the stadiums in the Olympic Green



1: National Stadium (Bird's Nest)
2: National Swimming Centre (Water Cube)
3: Olympic Tennis Center
4: Yingdong Swimming Center
5: National Indoor Stadium

National Stadium (Bird's Nest), National Swimming Centre (Water Cube), Olympic Tennis Center, Yingdong Swimming Center, and National Indoor Stadium were new and renovated stadiums located in the Olympic Green. Beijing Olympic Green including Stadiums Area, Olympic Village, and Olympic Forest Park was the Olympic park built for

2008 Olympic Games. It was located in the northern part of Beijing. It was very convenient to visit the Olympic Green by public transportation. There were five subway stations near the Olympic Green: North Tucheng Station, South Gate of the Forest Park Station, Anli Road Station, Olympic Center Station, and Olympic Park Station[4]. There were 38 bus stops near the Olympic Green[5]. The following table showed the public transportation situation of all the new and renovated stadiums in the Olympic Green.

Table 6 the public transportation situation of all the new and renovated stadiums in the Olympic Green

Stadium's Name	Subway Lines	Bus Lines
All the new and renovated stadiums located in the Olympic Green (National Stadium, National Swimming Centre, Olympic Tennis Center, Yingdong Swimming Center, and National Indoor Stadium)	No.8, No.10	No.108, No.124, No.328, No.379, No.380, No.387, No.408, No.419, No.426, No.479, No.620, No.645, No.653, No.694, No.984, No.11, No.19, No.2, No.81, No.311, No.110, No.113 and so on

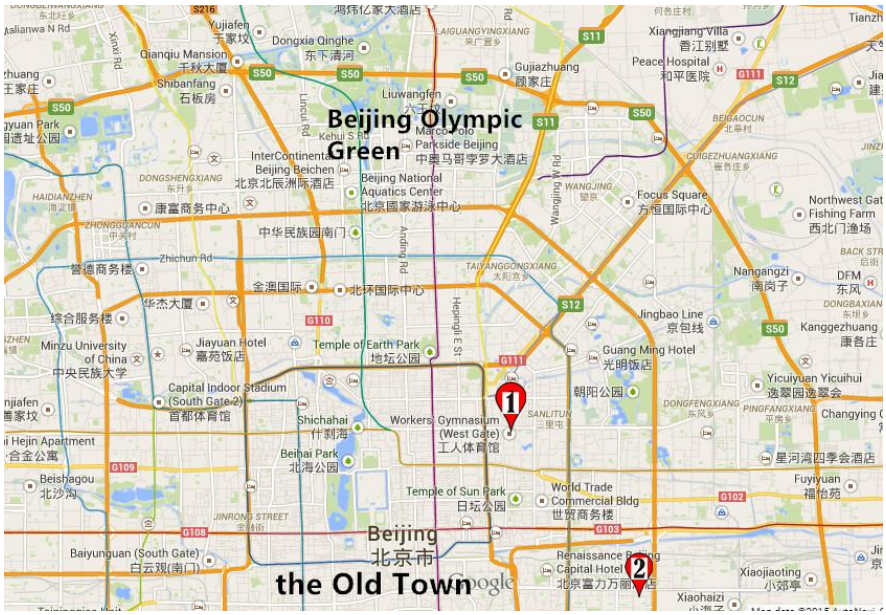
Source: http://www.bjsubway.com/ and http://www.bjbus.com/home/index.php

The Olympic Green was located in the urban area of Beijing, which indicated that it was not far from the Old Town. It only cost drivers less than 30 minutes to drive there if the traffic was good. As a result, the ample parking lots which can made drivers feel more convenient close to the Olympic Green were important. There were six large public parking lots near Beijing Olympic Green[6]. All of these six parking lots were pay parking lots. The largest parking lot was National Indoor Stadium Parking Lot. The price of this parking lot was 6 Chinese dollars[7] per hour, which was considered as an affordable price by some visitors and

[4] Beijing Subway official website http://www.bjsubway.com/
[5] Beijing Bus System official website http://www.bjbus.com/home/index.php
[6] These six parking lots were only 500 meters from the Olympic Green. The author used distance measure tool to find the distance between the parking lots and the Olympic Green on Baidu Maps.
[7] 6 Chinese dollars= 0.95 US dollars

local residents. Besides, People can also park their cars there. The price which was charged by meter was about 5 Chinese dollars per hour.

Figure 13 the location of Beijing Workers' Stadium and Beijing University of Technology Gymnasium



1: Beijing Workers' Stadium
2: Beijing University of Technology Gymnasium

Beijing Workers' Stadium and Beijing University of Technology Gymnasium were located in the northeastern part of Beijing. There were two subway stations near Beijing Workers' Stadium: East Sishitiao Station and Tuanjie Lake Station. Three bus stations were close to Beijing Workers' Stadium: Workers' Stadium Bus Stop, Western Gate of Workers' Stadium Bus Stop, and South Gate of Workers' Stadium Bus Stop. The nearest subway station of Beijing University of Technology Gymnasium was Jingsong Station. There were two bus stops close to Beijing University of Technology Gymnasium. The following table showed the public transportation situation of these two stadiums.

Table 7 the public transportation situation of Beijing Workers' Stadium and Beijing University of Technology Gymnasium

Stadium's Name	Subway Lines	Bus Lines
Beijing Workers' Stadium	No.2, No.10	No.3, No.110, No.113, No.115, No.118, No.120, No.208, No.403, No.16, No.416, No.431, No.673, No.701, No.758, No.515, No.615
Beijing University of Technology Gymnasium	No.3	No.30, No.34, No.486, No.649, No. 605, No.601, No.621, No.938, No.973, No.985, No.988

Source: http://www.bjsubway.com/ and http://www.bjbus.com/home/index.php

The public parking lots near Worker's Stadium are not ample. There is no free parking lot near this stadium. There is a huge parking lot located close to its western gate. The price is about 5 Chinese dollars[8] per hour. In every night, especially in the nights with competition games or performance, it is hard to find a parking place. The following table showed the public parking places close to these three sports stadiums.

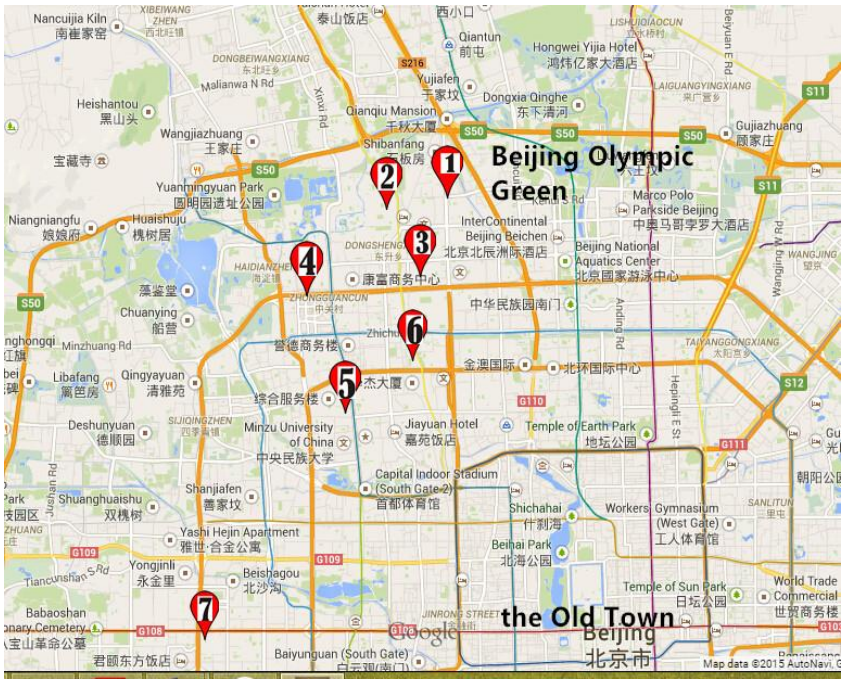
Table 8 the public parking places close to Beijing Workers' Stadium and Beijing University of Technology Gymnasium

Stadium's Name	Number of Free Public Parking	Number of Pay Parking Lots
Beijing Workers' Stadium	0	1
Beijing University of Technology Gymnasium	0	1[9]

[8] 5 Chinese dollars = 0.8 US dollars

[9] 5 Chinese dollars (0.8 US dollars) per hour

Figure 14 the location of stadiums in University Area and Wukesong Stadium



1: China Agricultural University Gymnasium
2: University of Science and Technology Beijing Gymnasium
3: Beijing University of Aeronautics and Astronautics stadium
4: Peking University Gymnasium
5: Beijing Institute of Technology Gymnasium
6: Capital Gymnasium
7: Wukesong Stadium

China Agricultural University Gymnasium, University of Science and Technology Beijing Gymnasium, Beijing University of Aeronautics and Astronautics stadium, Peking University Gymnasium, Beijing Institute of Technology Gymnasium, and Capital Gymnasium were located in University Area in Handian district. Wukesong Stadium was also located in Handian district. All this stadiums were in the prosperous urban area of Beijing, which meant that people can easily visit these stadiums by public transportation. The following table showed the public transportation situation of these stadiums.

Table 9 the public transportation situation of stadiums in University Area and Wukesong Stadium

Stadium's Name	Subway Lines	Bus Lines
China Agricultural University Gymnasium	No.13, No.10	No.103, No.355, No.392, No.398, No.419, No.478, No.490, No.604, No.632, No.719, No.753, No.609, No.26, No.628, No.913, No.963
University of Science and Technology Beijing Gymnasium	No.10	No.307, No.484, No.630, No.690, No.617, No.848, No.86, No.719, No.753
Beijing University of Aeronautics and Astronautics stadium	No.10, No.2	No.103, No.331, No.375, No.386, No.392, No.398, No.438, No.478, No.490, No.498, No.604, No.632, No.719, No.743, No.748, No.810, No.836, No.944
Peking University Gymnasium	No.13, No.14	No.307, No.320, No.355, No.365, No.681, No.697, No.699, No.717, No.731, No.801, No.4, No.6, No.105
Beijing Institute of Technology Gymnasium	No.4, No.2	No.563, No.103, No.645, No.26, No.651, No.300, No.8, No.699, No.10, No.374, No.108, No.109
Capital Gymnasium	No.4	No.92, No.332, No.27, No.87, No.105, No.107, No.111, No.332, No.334
Wukesong Stadium	No.1	No.740, No.751, No.713, No.952, No.981, No.982, No.983, No.996

Source: http://www.bjsubway.com/ and http://www.bjbus.com/home/index.php

The stadiums in University Area and Wukesong Stadium were all located in the prosperous urban area of Beijing. It didn't cost drivers too much time to drive to these stadiums. The following table showed the public parking places close to these three sports stadiums.

Table 10 the public parking places close to stadiums in University Area and Wukesong Stadium

Stadium's Name	Number of Free Public Parking	Number of Pay Parking Lots
China Agricultural University Gymnasium	0	5 (Jinma Parking lot, China Agricultural University Parking lot, China Agricultural University Meeting Center Parking lot, Xiaoyuehe Parking lot, and Xueqing Road Parking lot)[10]
University of Science and Technology Beijing Gymnasium	0	2 (University of Science and Technology Parking lot and Shiyoudayuan Parking lot)[11]
Beijing University of Aeronautics and Astronautics stadium	0	8 (Beijing University of Aeronautics and Astronautics Boyan Parking lot, Beijing University of Aeronautics and Astronautics Shining Parking lot and so on)[12]
Peking University Gymnasium	0	16 (Peking University Parking lot, Zihexin Parking lot and so on)[13]
Beijing Institute of Technology Gymnasium	0	2 (Beijing Institute of Technology Parking lot, and South Gate of Beijing Institute of Technology Parking lot)[14]
Capital Gymnasium	0	15[15]
Wukesong Stadium	0	6 (Wukesong Parking lot, Yinxiang Parking lot, and so on)[16]

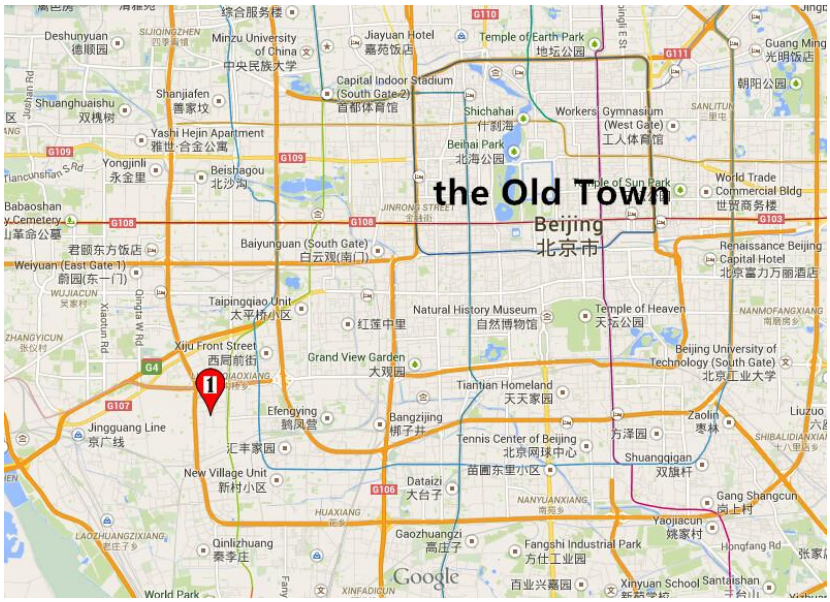
Source: http://www.dianping.com/

From the above table, no free parking lot was located near the above stadiums. People

[10] The largest parking lot was China Agricultural University Parking lot. The price was 5 Chinese dollars (0.8 US dollars) per hour.
[11] The largest parking lot was University of Science and Technology Parking lot. The price was 5 Chinese dollars (0.8 US dollars) per hour.
[12] The largest parking lot was Beijing University of Aeronautics and Astronautics Boyan Parking lot. The price was 2 Chinese dollars (0.3 US dollars) per hour.
[13] The largest parking lot was Peking University Parking lot. The price was 5 Chinese dollars (0.8 US dollars) per hour.
[14] The price in Beijing Institute of Technology was 8 Chinese dollars (1.3 US dollars) per hour and 200 Chinese dollars (32 US dollars) for one year.
[15] The prices of most parking lots in Capital Gymnasium were 5 Chinese dollars (0.8 US dollars) per hour.
[16] The largest parking lot was Wukesong Parking lot. The price was 6 Chinese dollars (1 US dollars) per hour.

had to pay for parking. The pay parking lots near Beijing Institute of Technology Gymnasium as well as University of Science and Technology Beijing Gymnasium were few, which may cause visitors and local residents inconvenient. In addition, many people believed that the price was affordable. They cared more about the parking places.

Figure 15 the location of Fengtai Softball Palestrae



1: Fengtai Softball Palestrae

Fengtai Softball Palestrae was located in Fengtai district next to the Western Fourth Ring Road. Wukesong Subway Station was close to Fengtai Softball Palestrae. The following table showed the public transportation situation of Fengtai Softball Palestrae.

Table 11 the public transportation situation of Fengtai Softball Palestrae

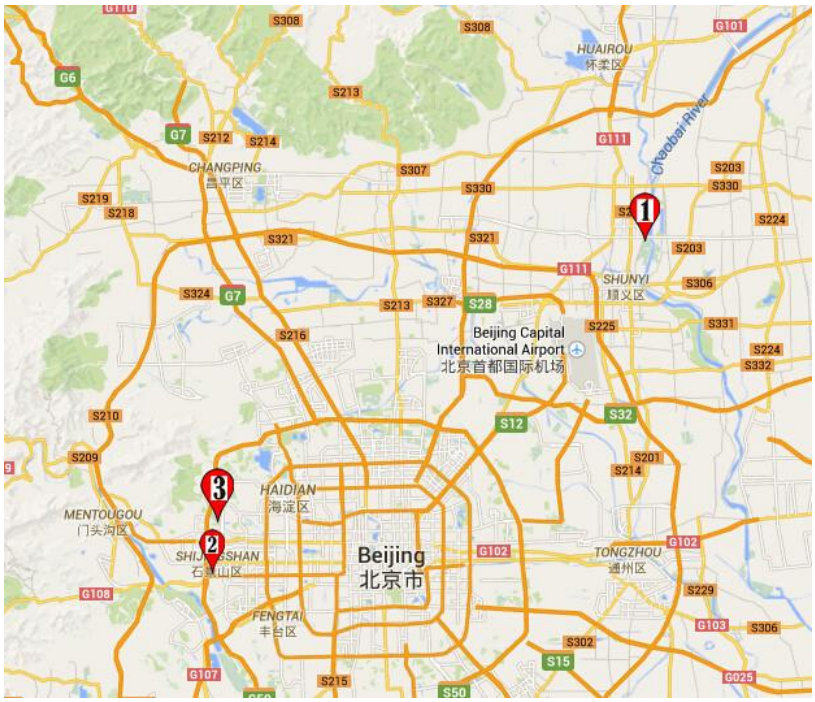
Stadium's Name	Subway Lines	Bus Lines
Fengtai Softball Palestrae	No.1	No.310, No.313, No.338, No.351, No.657, No.804, No.958, No.996

Source: http://www.bjsubway.com/ **and** http://www.bjbus.com/home/index.php

The public parking lots near Fengtai Softball Palestrae were few. There was only one parking lot which only had 400 parking places near Fengtai Softball Palestrae. This small parking lot was only open to people who held the parking permit. Besides, there were some parking lots along the roadside. People without parking permit can park their cars there. The

price which was charged by meter was about 5 Chinese dollars[17] per hour. In general, it was not a good choice for people to visit Fengtai Softball Palestrae by private cars due to the limited public parking places.

Figure 16 the location of Shunyi Olympic Water Park, Laoshan Velodrome, and Beijing Shooting Range CTF



1: Shunyi Olympic Water Park
2: Laoshan Velodrome
3: Beijing Shooting Range CTF

Shunyi Olympic Water Park was located in Shunyi district. Laoshan Velodrome and Beijing Shooting Range CTF were located in Shijingshan district. Shijingshan district belonged to the urban area of Beijing and Shunyi district belonged to the suburban area of Beijing. There was no subway station near Shunyi Olympic Water Park. If people wanted to visit this stadium by public transportation, they had to take buses. No.3 bus can take people to Shunyi Olympic Water Park. It was more convenient to visit Laoshan Velodrome and Beijing Shooting Range CTF compared to Shunyi Olympic Water Park. Bajiao Subway Station was close to these two stadiums. Subway line No.1 can bring people to these two stadiums. The following table showed the public transportation situation of the above three stadiums.

[17] 5 Chinese dollars= 0.8 US dollars

Table 12 the public transportation situation of Shunyi Olympic Water Park, Laoshan Velodrome, and Beijing Shooting Range CTF

Stadium's Name	Subway Lines	Bus Lines
Shunyi Olympic Water Park	None	No.3
Laoshan Velodrome	No.1	No.325, No.327, No.527, No.959, No.354, No.389
Beijing Shooting Range CTF	No.1	No. 803, No.696, No.740

Source: http://www.bjsubway.com/ and http://www.bjbus.com/home/index.php

Since the above three sports stadiums were not located in the populated urban area[18], it was quite convenient for people to drive to these three stadiums. People can visit Laoshan Velodrome and Beijing Shooting Range CTF through Western Fifth Ring Road. The public parking lots are ample. The following table showed the public parking places close to these three sports stadiums.

Table 13 the public parking places close to Shunyi Olympic Water Park, Laoshan Velodrome, and Beijing Shooting Range CTF

Stadium's Name	Number of Free Public Parking	Number of Pay Parking Lots
Shunyi Olympic Water Park	1 (with 800 parking places)	12[19]
Laoshan Velodrome	1	24[20]
Beijing Shooting Range CTF	1	27

Source: http://www.aibang.com/detail/1655373532-1205405208

[18] Beijing populated urban area included the Old Town, Chaoyang district, and Handian district.
[19] The prices of most parking lots were 2 Chinese dollars (0.3 US dollars) per hour
[20] The prices of most parking lots were 5 Chinese dollars (0.8 US dollars) per hour

4.2 Study Area for Beijing Olympic Forest Park

This part described the location and basic information of Beijing Olympic Forest Park, and stated the transportation situations of the Forest Park.

4.2.1 The location and basic information of the Olympic Forest Park

Forest park, also called Beijing's Olympic Forest Park, was located at the north end of the Olympic Green which was located in Chaoyang district, the north part of the Beijing urban area. Beijing Olympic Forest Park was divided into two parts by Beijing North Fifth Ring Road consisting of the North Park which covered 791 acres and the South Park which covered 890 acres.

Beijing Olympic Forest Park covered an area of 1680 acres totally. The north boundary of the Forest Park was Qing River. This Olympic facility was embraced by Xindiancun Road to its south, Anli Road to its east, and Baimiaocun Road to its west. The north side of a huge lake located inside had a mountain that gave an excellent view of this part of the city. Nowadays, Forest Park consisted of 14 historical sites and cultural relics including 11 historical tombstones, 2 stone inscriptions, and one Dragon King Temple. All the historical sites which were valuable can attract tourism were preserved in the Forest Park. It also had a large area of green land and wetland. Woodland and forests covered an area of one thousand acres. Lakes and wetland covered an area of 64 acres. (Shengdong Ye 2008) As the largest urban park in Beijing urban area, Beijing Olympic Forest Park was widely expected to be a green lung to Beijing, a gene pool for the species living in Beijing area, and a water reservoir in order to provide all Beijing residents good-quality water. The following figure showed the

location of the Olympic Forest Park in the Olympic Green.

Figure 17 the location of the Olympic Forest Park.in the Olympic Green

Source:
http://www.turenscape.com/english/projects/project.php?id=298

4.2.2 The planning and design of the Forest Park

Olympic Forest Park was a large, man-made nature park at the north end of Beijing's north-south central axis. It was an extension to the north of Beijing's north-south central axis. The landscape architecture design was led by Hu Jie, the director of the Landscape Planning and Design Institute at the Urban Planning and Design Institute of Tsinghua University. Hu

Jie designed and created an "Axis of Nature"[21] in order to express the Chinese traditional beauty. In accordance with traditional Feng Shui practice, this involved a hill at the north and a lake to the south. The hills, woods and water concept were however along the lines of China's imperial parks – and were very appropriate to Beijing's climate (gardenvisit.com). The hills and water usually stand for the harmony and the beauty of pure nature in Chinese traditional culture. In addition, the combination of hills, woods and water also represented the good fortune of a family or even a nation according to Chinese traditional Feng Shui culture. This very location and design can be considered as a religious blessing to all the local residents and the city of Beijing.

An expressway which crossed the park had been designed as a "green bridge" ecological corridor over Beijing's Fifth Ring Road. It linked the southern and northern parts of the forest park and was intended to be a landmark. The Olympic Forest Park had subway stations, an open air theater, a lake, and a sophisticated system for bubbling air into the water for purification.

4.2.3 The transportation of Beijing Olympic Forest Park

The transportation of Beijing Olympic Forest Park was advanced and developed. It was connected with the rest part of the city with roads, buses, and subways. People can visit the Forest Park conveniently.

The Forest Park was surrounded by Qing River, Qing River Street, and Walisan Street (to its north), Xindiancun Road (to its south), Anli Road (to its east), and Baimiaocun Road (to its west). Baimiaocun Road, Xindiancun Road, and Anli Road are Beijing main roads. Qing

[21] gardenvisit.com

River Street and Walisan Street were the secondary roads. In addition, Beijing Olympic Forest Park was divided into two parts by Beijing North Fifth Ring Road including the North Park and the South Park. Beijing North Fifth Ring Road is a main ring freeway in Beijing. Besides, Beichen West Road and Beichen East Road were two main north-south secondary roads in the Forest Park linking the north part of the Park with the south part. Moreover, the roads in the Forest Park were narrower than the roads outside, the majority of which were only three meters wide. Cars and other large vehicles were not allowed in the Forest Park except some emergency situations. The most common vehicles used by the visitors in the Park were electrical vehicles.

There were plenty of bus stops near Beijing Olympic Forest Park. Visitors and local residents can go to the Forest Park by buses including bus No.417, No.538[22] and so on. There are one main bus transfer stations and tens bus stops near the Forest Park. Every bus transfer stations and bus stops were close to the entrance and exit gates of the Forest Park, which provided visitors and local residents with great convenience to walk from bus stations to the entrance and exit gates.

It was very convenient to visit the Forest Park by subway from any rest urban areas in Beijing. There were two subway station near the Forest Park. The following table showed the transportation situation of Olympic Forest Park.

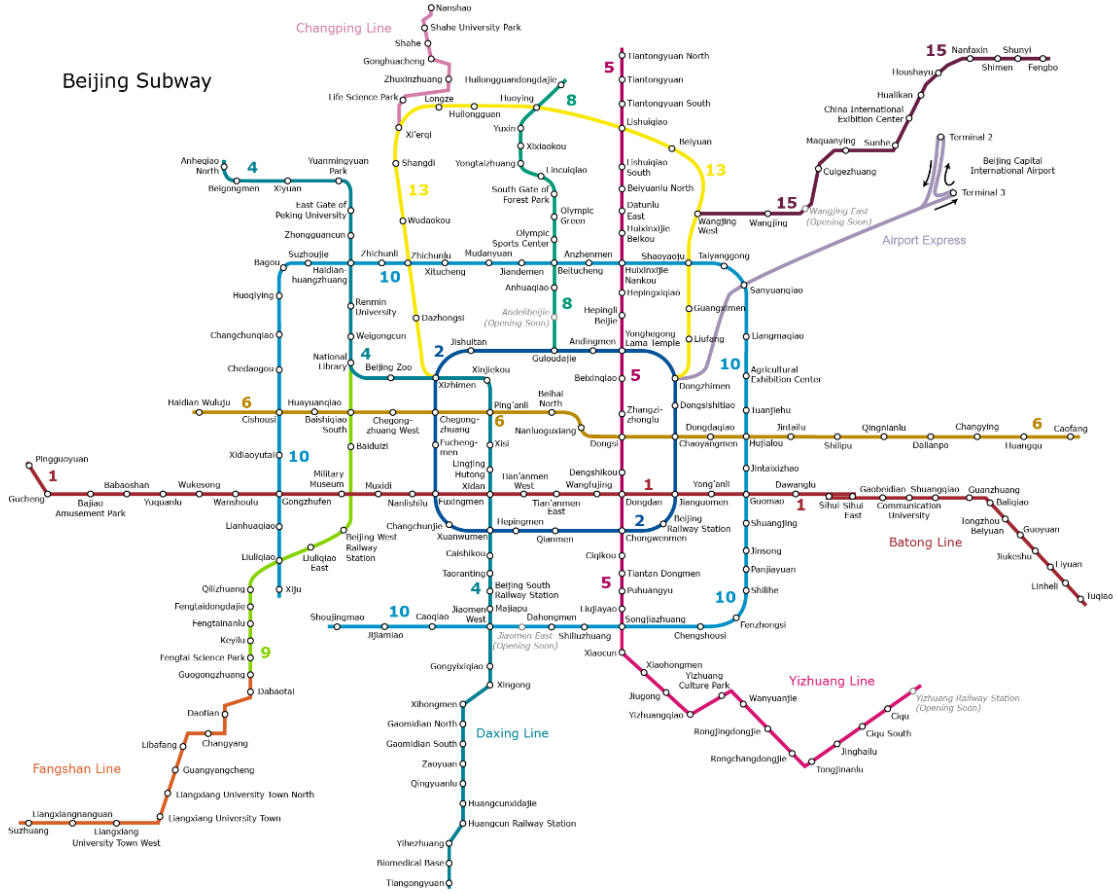
Table 14 the transportation situation of Olympic Forest Park.

Facility's Name	Subway Lines
Beijing Olympic Forest Park	No.8

Source: Beijing Subway official website http://www.bjsubway.com/

[22] Beijing Bus System official website http://www.bjbus.com/home/index.php

Figure 18 Beijing Subway System Map



Source: Beijing Travel website http://www.beijingchina.net.cn/transportation/subway.html

The public parking lots around the Forest Park were sufficient in general. Beijing Olympic Forest Park had 10 large parking lots for bicycles and 9 large parking lots for autos including around 5,831 parking spaces inside. There were nine main public parking lots around Olympic Forest Park: Beijing Olympic Forest Park South Gate of the North Park parking lot, Beijing Olympic Forest Park Western Gate of the North Park parking lot, and so on. All the above parking lots were open to the public 24 hours and seven days. They were pay parking lots. The parking fee was 2 Chinese dollars[23] per hour in Beijing Olympic Forest Park North Gate of the South Park parking lot, the largest parking lot close to the Forest Park, which was affordable for the majority of the owners of the private cars. However,

[23] 2 Chinese dollars = 0.3 US dollars

some anonymous citizens always complained that the parking space in every parking lot was not very large. Some new drivers who were inept at parking skills may feel hard to make their cars parked properly. In addition, there were many parking spaces along the bank of streets, the most of which are charged by parking meters.

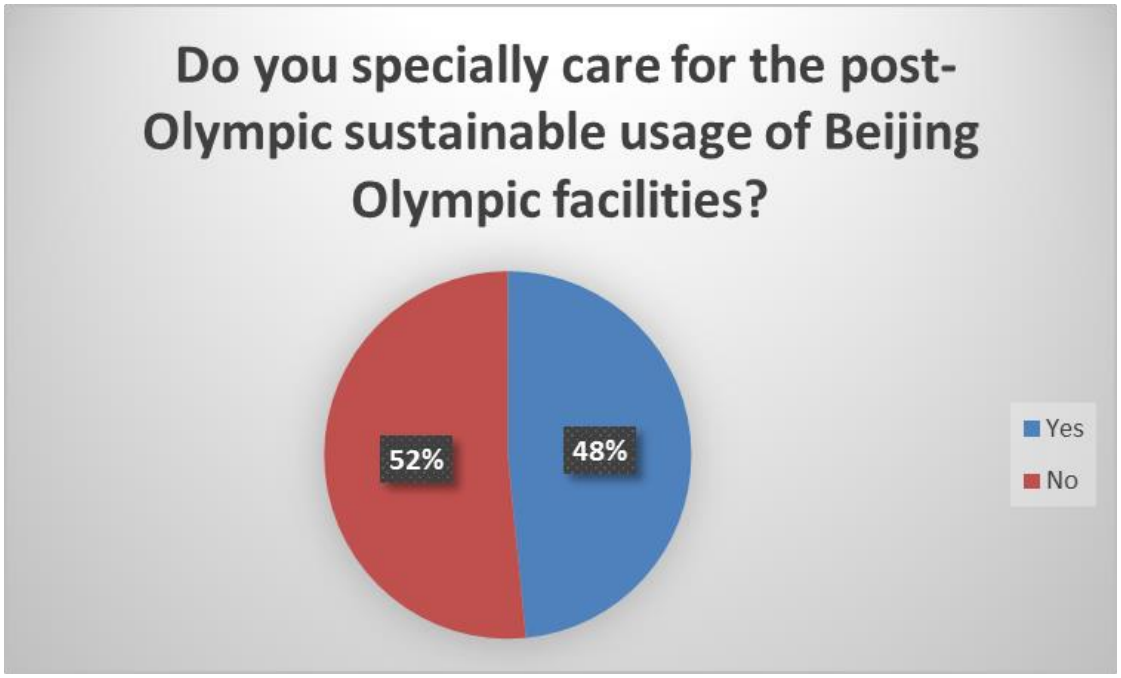
Chapter 5 Findings and Discussion

This chapter discussed the reuse situation of Beijing Olympic stadiums, facilities, and Forest Park in economic, environmental, and social equitable dimensions; gave the recommendations for Olympic stadiums as well as Forest Park in order to help them sustainable reused after the Olympics.

5.1 Findings and discussion of Beijing Olympic stadiums

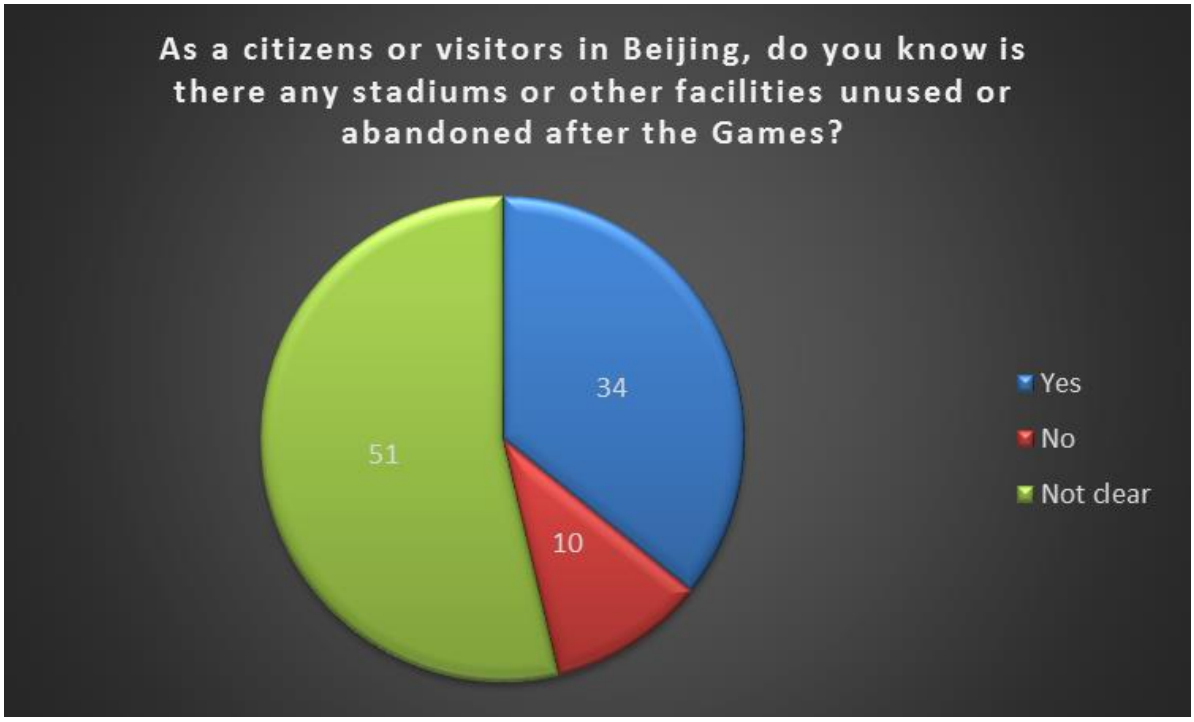
The results of the questionnaires was an important feedback which can represent survey participants' opinions from the local residents and visitors towards the Olympic stadiums. Around 95 questionnaires including 31 questions focusing on the three dimensional nature of sustainable development (economic, social equitable, and environmental) of Beijing Olympic stadiums and facilities were done during the field trip in Beijing. The questions on Forest Park mainly focused on the economic and social equitable dimensions. Before I present details of findings related to the economic and social equitable dimensions, I will introduce findings on general opinions of sustainable post-Olympic usage of the Olympic stadiums.

Figure 19 Question #1 Do you specially care for the post-Olympic sustainable usage of Beijing Olympic facilities?



Over half of the survey participants answered they didn't care for the post-Olympic usage of Beijing Olympic facilities. Question #1 showed whether survey participants specially care for the post-Olympic sustainable usage of Beijing Olympic facilities. From the above figure, about 48.24% survey participants said they care for the post-Olympic sustainable usage of Beijing Olympic facilities. Over 50% survey participants answered no. It indicated that many people didn't understand the significance of the sustainable reuse of Beijing Olympic stadiums. Local government needed to do a lot in order to improve the public concerns and public participations on post-Olympic sustainable usage.

Figure 20 Question #2 as a citizens or visitors in Beijing, do you know is there any stadiums or other facilities unused or abandoned after the Games?



The majority of the survey participants said that they knew some stadiums or facilities were abandoned after the Games. Question #2 investigated that whether survey participants believed the Olympic stadiums and facilities were used well or not after 2008 Olympic Games. From the above figure, about 53.68% survey participants said they were not clear about whether there was stadiums or other facilities unused or abandoned after the Games, which indicated that the majority of survey participants didn't care for the post-Olympic usage of stadiums and Olympic facilities. Local government was weak in propaganda. About 35.79% survey participants answered that there was stadiums or other facilities unused or abandoned after the Games. Only about 10.53% survey participants answered no. Some survey participants also listed some stadiums they believed to be abandoned after the Games. The following table showed their opinions about which stadiums were abandoned after the Olympics.

Table 15 survey participants' opinions about which stadiums were abandoned after the Olympics

Stadium's Name	The number of survey participants who believe this stadium was unused or abandoned after the Olympics
Olympic Tennis Center	2
Shunyi Olympic Water Park	1
Fengtai Softball Palestrae	1
Laoshan Velodrome	2
National Swimming Center (Water Cube)	1

Some survey participants believed that Olympic Tennis Center, Shunyi Olympic Water Park, Fengtai Softball Palestrae, and Laoshan Velodrome were abandoned or at least not reused well after the Games. To the author's astonishment, there was one survey participant pointed out that he believed Water Cube was unused or abandoned after the Olympics. Question #2 represented that most survey participants were not satisfied about the post-Olympic usage of Beijing Olympic stadiums and facilities.

Many survey participants believed National Stadium, Olympic Forest Park, and National Swimming Center were reused well after the Games. Question #3 investigated survey participants' opinions towards which stadium was sustainable used after the Games. The following table showed the results of this question.

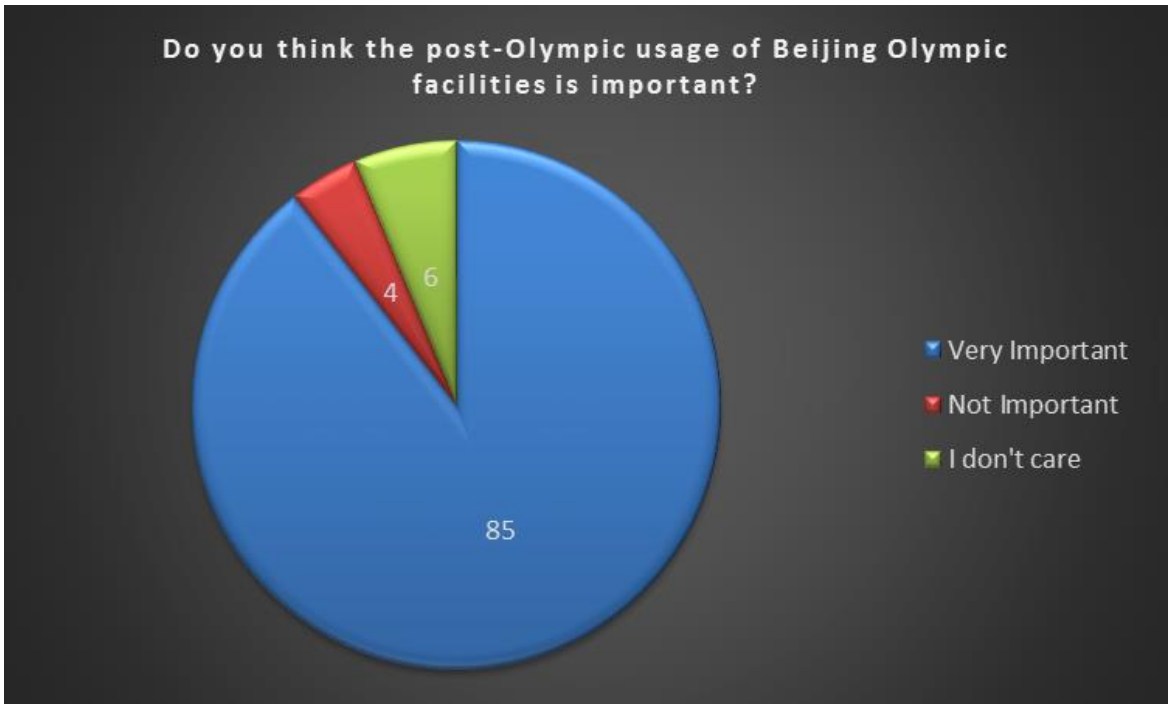
Table 16 the number of survey participants who believe this stadium was sustainable used after the Olympics

Stadium's Name	The number of survey participants who believe this stadium was sustainable used after the Olympics	Percentage (%)
National Stadium (Bird's Nest)	34	40.00%
Olympic Forest Park	15	17.65%
National Swimming Center (Water Cube)	27	31.76%
Yingdong Swimming Center	1	1.18%
Beijing Workers' Stadium	2	2.35%
National Indoor Stadium	2	2.35%
Wukesong Stadium	4	4.71%

Only eighty five survey participants were willing to answer the above question during the field trip. Most of them answered that National Stadium (Bird's Nest), Olympic Forest Park, and National Swimming Center (Water Cube) were sustainable used after the Games. Some people also named Yingdong Swimming Center, Beijing Workers' Stadium, and so on.

The main reason why so many people answered National Stadium, Olympic Forest Park, and National Swimming Center was that many survey participants were visitors, most of who only knew and visited Bird's Nest and Water Cube since these two stadiums were too famous. As a result, the result of this question may be a little bit subjective and should be considered with other factors.

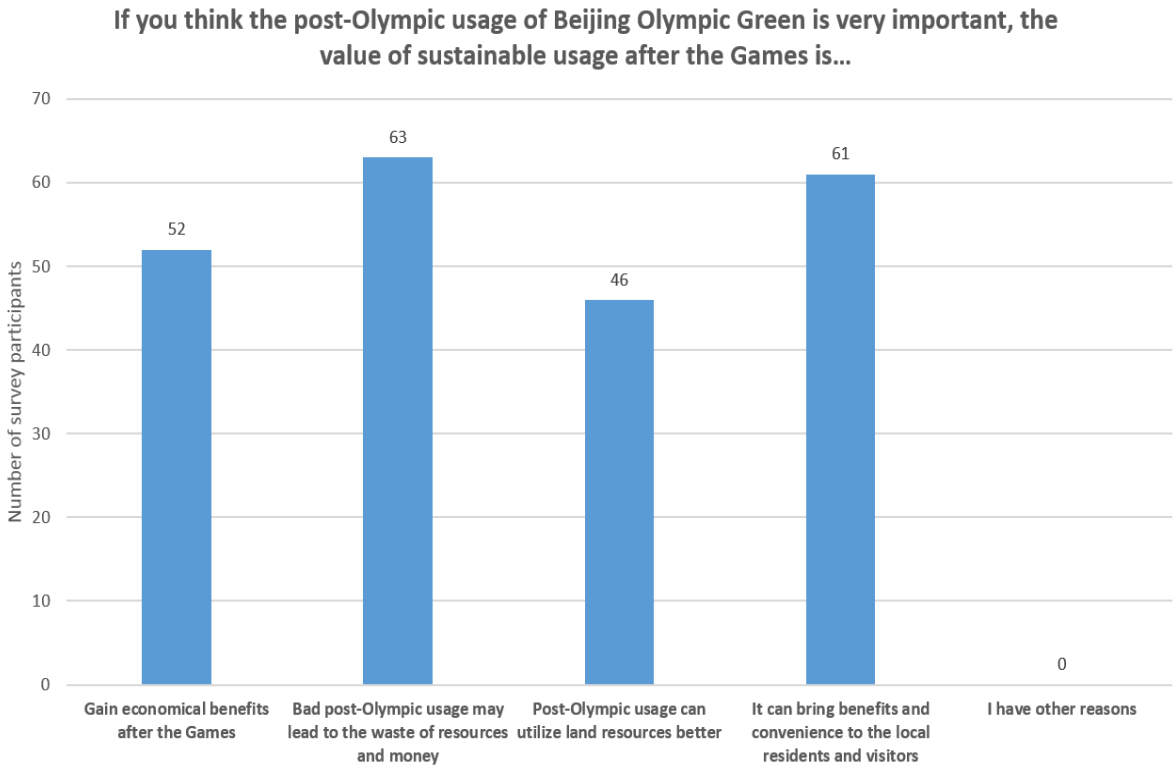
Figure 21 Question #4 do you think the post-Olympic usage of Beijing Olympic facilities is important?



Most survey participants realized the importance of the post-Olympic usage of Beijing Olympic stadiums and facilities. Question #4 investigated survey participants' attitudes towards the importance of the post-Olympic usage of Beijing Olympic stadiums and facilities. It was good to find that about 89.47% survey participants said the post-Olympic usage of Beijing Olympic facilities is very important.

Many survey participants believed that the sustainable reuse of Beijing Olympic stadiums and facilities after the Games can bring a huge number of benefits including gaining economic benefits after the Games; avoiding bad post-Olympic usage which may lead to the waste of the money as well as resource; utilizing land resource better; bring benefits and convenience to local residents and visitors.

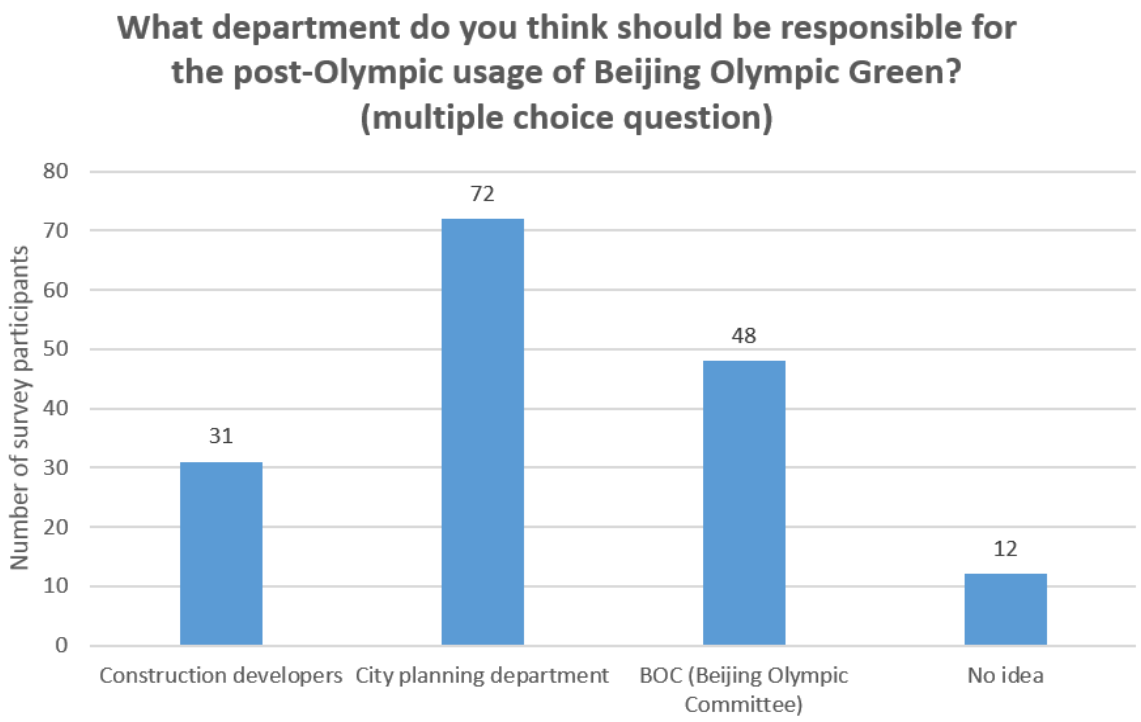
Figure 22 Question #5 if you think the post-Olympic usage of Beijing Olympic Green is very important, the value of sustainable usage after the Games is…



Most survey participants believed City planning department should be responsible for the post-Olympic usage of Beijing Olympic stadiums and facilities. In addition, some survey participants also answered that they believe some public or private construction developers, or Beijing Olympic Committee should be responsible for it. Actually, after the Games, Beijing Olympic Committee terminated its work and was disbanded. All of the Olympic stadiums and facilities were owned by the state. Beijing government and a state-owned cooperation named China Guo'Ao Group signed several agreements to sell the operation right of some of Olympic stadiums to this cooperation. Some Olympic stadiums such as Laoshan Velodrome was owned and operated by Beijing government since Guo'Ao Group and other cooperation were not willing to buy its operation right because of its bad reused situation. Some Olympic stadiums such as the stadiums located in the University Area

including Beijing University of Technology Gymnasium were owned by local government and operated by the universities since local government tend to make these stadiums provide service for the students studying in Beijing. As a result, universities got the operation right from local government without any payment. (Zipu Wang, Jinhui Liang 2012)

Figure 23 Question #7 what department do you think should be responsible for the post-Olympic usage of Beijing Olympic Green? (Multiple choice question)



5.1.1 The economic dimension of the usage of Beijing Olympic stadiums after the Games

Most Olympic stadiums were not reused well in economic dimension according to the survey participants' opinions and the author's observation. Based on the limited data, Beijing Workers' Stadium was reused well in economic dimension. National Stadium and National Swimming Center were at average level on post-Olympic economic usage. I did some interviews with the officials working in the institutions or corporations on post-Olympic usage of Beijing Olympic venues during the site visiting. Ms. Tian, an administrative officer

in Beijing Development and Reforming Office, said she cannot gave the detailed data on economic usage of Olympic stadiums to me because non-government people were not allowed to obtain and use such data. As a result, I used the SEI (Social Equitable Index) to measure social equitable usage of each Olympic stadium but cannot use the similar index to measure economic usage of each Olympic stadium due to the limited data. Based on the limited data, the results of surveys and interviews with local residents and visitors, and my observation, this thesis chose four typical Olympic stadiums to discuss the post-Olympic usage in economic dimension.

Beijing Workers' Stadium renovated for 2008 Beijing Olympic Games was the home field of Beijing Guo'An Football Club after the Olympics. This government-owned sports stadium was leased to Guo'An Club for twenty years. After that, Beijing government and Guo'An Club were going to sign a new lease agreement every twenty years. According to the lease, Guo'An Club was supposed to pay at least 9 million Chinese[24] dollars to Beijing government. If Beijing Guo'An football team played well and got a rank at the top in the Chinese Football Super League, which made Beijing Guo'An team qualified for Asian Football Champion League, Guo'An Club should pay 450 thousand Chinese dollars every Asian Champion League game for using Workers' Stadium to Beijing government. From 2006, Beijing Guo'An team attended every Asian Champion League. As a result, it was expected for Beijing government to get about 11.7 million Chinese dollars[25] from Beijing Workers' Stadium every year[26].

[24] 9 million Chinese= 1.429 million US dollars

[25] 11.7 million Chinese dollars= 1.857 million US dollars

[26] According to the competition agenda of Asian Champion League, there are six games in the group phrase. The top two teams in each group are qualified for the next knockout games. Every team should play at least six games. As a result, Beijing Guo'An team should pay at least 2.7 million Chinese dollars to Beijing government every year if it attend Asian

Although some scholars argued that it was very difficult for the government to make profits if the government rented the sports stadiums out to local professional sports teams nowadays because the profits gained by local professional sports teams were shrinking. Reduced profits for teams signified reduced rents for municipalities. (Robert A. Baade, Richard F. Dye 1990) The situation in China, especially in Beijing, was different from the rest of the world.

There were a mass of evidences to prove that the profits gained by Beijing Guo'An Club were not shrinking, especially from team attendance as well as the share of the dividend.

The team attendance of Beijing Workers' Stadium was high, which made ticket price an important part of Beijing Guo'An Club income. According to the statistical data, every Wednesday and Sunday night in 2014, about 38,533 Guo'an fans entered Worker's Stadium in order to watch a soccer match[27]. The team attendance for every match was very high because of the following reasons. Firstly, after the Olympics, a large number of temporary seats were moved. Beijing Worker's Stadium had about 65,000 permanent seats now. The seats occupancy rate was about 60%, which was over the majority of other countries. Moreover, usually during a soccer match, some seats should be vacant for security reasons and some spectator areas should be keep vacant for the visiting team fans. As a result, the available seats were much less than 65,000. Most available seats were occupied by Guo'An fans. The following tables showed some football clubs with the high average seats occupancy rates in the world (Table X) and some football clubs with the high average seats occupancy rates in the Asia (Table Y). The average attendance of Beijing Guo'An Club ranked in 38th in

Champion League.

[27] Sohu Sports Website 2014 http://sports.sohu.com/20141024/n405402166.shtml

the world and 2nd in the Asian, which was really high because there are hundred thousands of football clubs in the world.

Table 17 some football clubs with the highest average attendance in the world in 2014[28]

World Ranking	Club's Name	Club's Nation	Average Number of People (attendance)
1	Dortmund	Germany	80,297
2	Manchester United	England	75,207
3	Barcelona FC	Spain	72,116
4	Real Madrid	Spain	71,558
		…	
35	Guangzhou Evergrande	China	40,428
36	Nuremburg	Germany	40,412
37	AC Milan	Italy	39,874
38	Beijing Guo'An	China	38,533
39	Lille	France	38,328

According to the ticket website[29], the average ticket price is about 100 Chinese dollars[30]. So these Guo'an fans can bring this stadium about 1,223,270 US dollars every week. The following figure was a picture for a competition day in Beijing Workers' Stadium.

[28] RSS Sports website http://www.bendijin.net/feed/en_188973

[29] China ticket official website 2014 http://www.chinaticket.com/view/11282.html

[30] 100 Chinese dollars= 16 US dollars

Figure 24 a picture for a competition day in Beijing Workers' Stadium

Source: http://news.yzdsb.com.cn/system/2011/04/29/011090623.shtml

In addition, every football team which attended Chinese Super League can receive at least 5 million Chinese dollars[31] as dividend from the League Committee in 2013. In 2014, the share of the dividend became 11 million Chinese dollars[32]. This number was expected to increase largely in the next few years. Because Beijing Guo'An club attended every Asian Champion League since 2006, it can also get the share of the dividend from Asian Football Association. The income from the share of dividend was very considerable. As a result, the profits gained by Beijing Guo'An Club were not shrinking, both from team attendance as well as the share of the dividend.

Moreover, Beijing Workers' Stadium was also one of the home field of Chinese national football team. It hosted some qualifiers for World Cup as well as Asia Cup after the Olympics.

[31] 5 million Chinese dollars= 0.794 million US dollars

[32] Phoenix News http://news.ifeng.com/a/20141111/42442550_0.shtml. 11 million Chinese dollars= 1.75 million US dollars

Beijing government was supposed to pay about 5 million Chinese dollars[33] to CFIDC (China Football Industry Development Corporation), a subsidiary of China Football Association. It is expected that Beijing government can earn much more money from selling the tickets as well as leasing advertising boards around the football field.

Beijing Workers' Stadium also hosted a large number of entertainment performances after the Games. The rent from these entertainment performances was considerable. The following table showed some main entertainment performances hosted in Beijing Workers' Stadium after the Olympics.

Table 18 main entertainment performances hosted in Beijing Workers' Stadium after the Olympics[34]

Time (m/d/y)	Entertainment performances
04/18/2009	Super Band Beijing Concert
07/11/2009	Super Junior the 3rd Asia Tour Concert
08/15/2009	Stefanie Sun World Tour Concert in Beijing
08/22/2009	Leehom Wang World Tour Concert in Beijing
10/24/2009	Wilber Pan World Tour Concert in Beijing
05/02/2010	Mayday World Tour Concert in Beijing
04/23/2011	Andy Lau World Tour Concert in Beijing
05/28/2011	Jolin Tsai World Tour Concert in Beijing
05/06/2012	Jacky Cheung World Tour Concert in Beijing
09/02/2012	Feng Wang World Tour Concert in Beijing
04/30/2013	Phoenix Legend Beijing Concert
10/12/2013	Yuan Zheng Asia Tour Concert
11/02/2013	Super Boys Beijing Concert
04/06/2014	Jack Chen Beijing Concert
05/07/2014	Jie Wang Beijing Concert
05/24/2014	Jay Chou World Tour Concert in Beijing
07/12/2014	Stefanie Sun Kepler World Tour Concert in Beijing
08/16/2014	Eason Chan World Tour Concert in Beijing

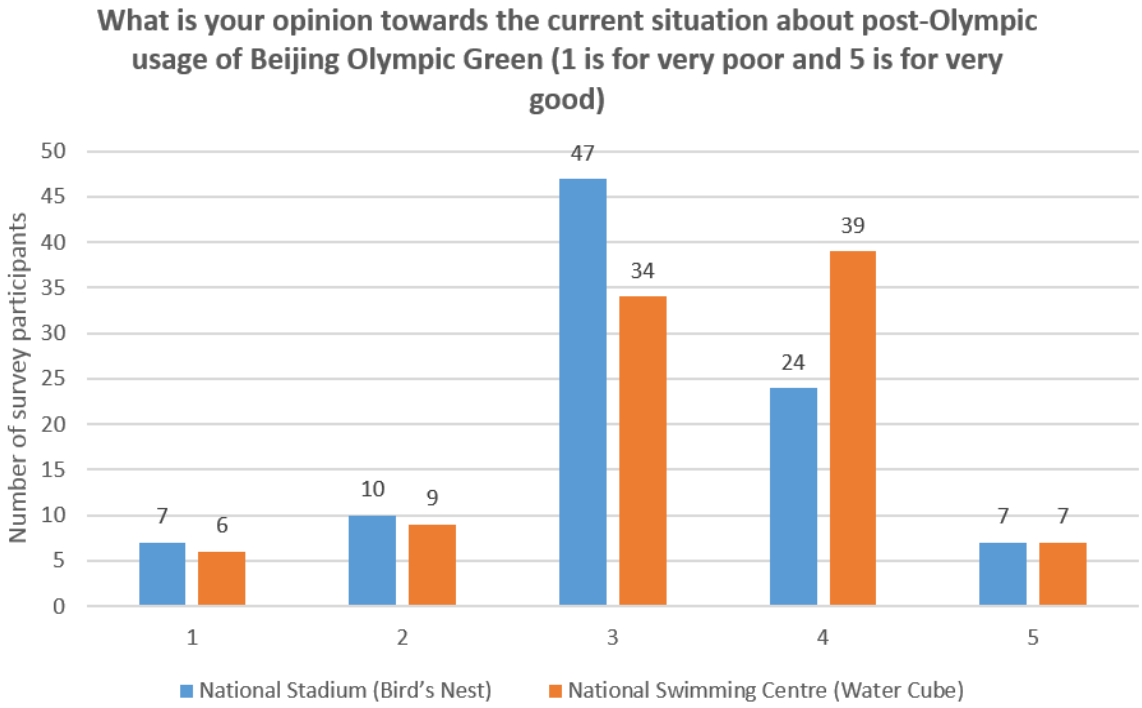
The post-Olympic usage of National Stadium (Bird's Nest) and National Swimming Center (Water Cube) were considered to be not as good as the usage of Beijing Workers'

[33] 5 million Chinese dollars= 0.794 million US dollars

[34] Juooo Performance Ticket website http://www.juooo.com/venue/show/340

Stadium. The huge stadium area and debt amortization made it hard to sustainable reuse these two stadiums, especially in economic dimension, after the Olympics.

Figure 25 Question #6 what is your opinion towards the current situation about post-Olympic usage of Beijing Olympic Stadiums or facilities (1 is for very poor and 5 is for very good)



According to the survey results of Question #6, most survey participants believed that the post-Olympic usage of National Stadium and National Swimming Center was at average level. About 49% survey participants believed that the post-Olympic usage of National Stadium was at the average level. About 36% survey participants believed that the post-Olympic usage of National Swimming Center was at the average level. 41% survey participants believed that the post-Olympic usage of National Swimming Center was good.

National Stadium (Bird's Nest) and National Swimming Center (Water Cube) were two new stadiums built for 2008 Beijing Olympic Games. These two stadiums cost Beijing government about 4.5 billion Chinese dollars[35], which immediately became a huge fiscal

[35] 4.4 billion Chinese dollars= 0.7 billion US dollars

burden after the Games. The huge construction costs were paid off before the Olympic Games by Beijing government and Chinese government. Besides, since these two stadiums were very large, the operation and maintenance fees were also very high. The annual operation and maintenance fees of these two stadiums were about 0.24 billion Chinese dollars[36] (Zipiao Wang, Jinhui Liang 2012).

Figure 26 Beijing National Stadium

Source: http://upload.wikimedia.org/wikipedia/commons/1/1e/Beijing_national_stadium.jpg

The post-Olympic usage of National Stadium can be divided into two periods. During the first period from September 2008 to 2009, Beijing government gained approximately 0.37 billion Chinese dollars[37] from selling entrance tickets. As a landmark building and the symbol of Beijing 2008 Olympic Games, National Stadium attracted many visitors and local residents in the first year. The large number of visitors stimulate the development of the surrounding stores, malls, and the whole region economy. The income from entrance ticket

[36] 0.24 billion Chinese dollars= 0.04 billion US dollars
[37] 0.3 billion Chinese dollars= 0.05 billion US dollars

occupied approximately 90% of the total income. (Zipiao Wang, Jinhui Liang 2012)

During the second period from 2009 till now, the profits gained from selling entrance tickets decreased a lot. Entrance ticket income of National Stadium was approximately 0.13 billion Chinese dollar per year. The income from entrance ticket occupied approximately 65% of the total income during the second period. (Zipiao Wang, Jinhui Liang 2012)

In addition, National Stadium also hosted many sports games and art performances after the Games. The following table listed the detailed information of the main sports games and art performances hosted in National Stadium. The income from hosting sports games and art performances occupied approximately 13% of the total income. (Zipiao Wang, Jinhui Liang 2012)

Table 19 main sports games and art performances hosted in National Stadium

Time (m/d/y)	Sports games and art performances
12/01/2008	Bird's Nest Happy Snow and Ice Season performance
04/26/2009	Bird's Nest photography performance
05/01/2009	Jack Chen and his friends Concert
08/08/2009	Italian Football Super Cup
09/06/2009	Opera performance *Tornado*
07/25/2010	Bird's Nest Soccer Cup
08/08/2010	Barcelona China Tour Soccer Game
10/03/2010	China National Opera House Performance
05/01/2011	Rolling Stones Bird's Nest Concert
05/28/2011	Beijing Baseball Tournament
07/16/2011	Bird's Nest Ball Football Game
08/06/2011	Italian Football Super Cup
09/05/2011	Sino-Korean Music Concert
02/29/2012	Leehom Wang Concert
04/29/2012	Mayday Concert
07/27/2012	England Super League Soccer Game
10/19/2013	SMtown Concert
08/02/2014	Wang Feng Bird's Nest Concert

From 2009 to the end of 2011, the total income of National Stadium was approximately

0.83 billion Chinese dollars. Beijing government can obtained about 0.2 billion Chinese dollars from National Stadium every year. The operation and maintenance fee each year was also approximately 0.2 billion Chinese dollars. (Zipiao Wang, Jinhui Liang 2012)

I visited Beijing Olympic Green in the summer 2014. The ticket price for Bird's Nest fell into two types: ordinary travel and further travel. The price for ordinary travel was 50 Chinese dollars[38]. The price for further travel was 80 Chinese dollars[39]. The difference between these two types of travel was that people who purchased further travel ticket can visit both 5th floor and 1st floor of National Stadium instead of only visiting 5th floor with ordinary travel ticket. The Olympic Green also provided the small train to take visitors from one stadium to another for the people who were willing to pay extra 30 Chinese dollars[40]. "I think the prices are affordable. This is the first time I and my family visit Beijing. I believe Bird's Nest will be impressive and attractive." said by Mr. Liu, a visitor from Guangzhou. He and his family visited Tiananmen Square and the Imperial Palace last day. He bought further travel tickets and small train tickets for his family since they don't want to walk in the Olympic Green under the hot sun in the summer.

I also talked with a staff working in the ticket window. This anonymous ticket lady said she had no idea about the exact amount of people visiting Bird's Nest every day. But she said that every person with a ticket had to wait in the entrance gate of the National Stadium for a battery car to take them to the security gate for security purpose. According to the author's estimates, every single battery car can take about 15 persons to security gate. There were 4 battery cars in the entrance gate. They went to security gate every 10 minutes. The opening

[38] About 8 US dollars
[39] About 12.7 US dollars
[40] About 4.8 US dollars

hours for Bird's Nest was from 9am to 8:30pm. As a result, around 4,140 persons visited Bird's Nest every day. If all of them buy the further travel ticket. These visitors can bring about 0.33 million Chinese dollars[41] to Bird's Nest every day.

National Stadium had six floors. Only the 1st floor and 5th floor were open to the public when the Bird's Nest didn't host games or events. The first floor included the wax museum of Olympic Committee presidents which was a gift built by Beijing Olympic Committee for Olympic Committee, Olympic media area which was a room provided for the journalists and media staffs working during the sports event and performance, photo gallery, service center, medical aid station, gift shops, and some convenience stores. The fifth floor of Bird's Nest included two viewing platforms, an exhibition hall showing props used in the opening and closing ceremonies 2008 Olympic Games, a photo gallery, an air corridor which was still under construction, and some convenience stores. Many convenience stores were closed that day, which made a lot inconvenience for the people visiting Bird's Nest. Mr. Liu and his family were very thirsty during the period of traveling. But he cannot find a store to buy some beverage. At length, his family decided to go out and buy some beverage on the street rather than continuing visiting the fifth floor of Bird's Nest. I also found that a lot of spaces in the Bird's Nest were wasted. No shopping center and no food and beverage store were in Bird's Nest at that day, visitors can only find a lot of restrooms in the first floor and the fifth floor. Bird's Nest had so many restrooms inside. Furthermore, visitors had to buy another ticket if they wanted to visit air corridor when it was complete. The ticket price for the air corridor is 40 Chinese dollars[42] per person. Children, students, soldiers serving in the army, and senior

[41] About 52.5 thousand US dollars
[42] Around 6.3 US dollars

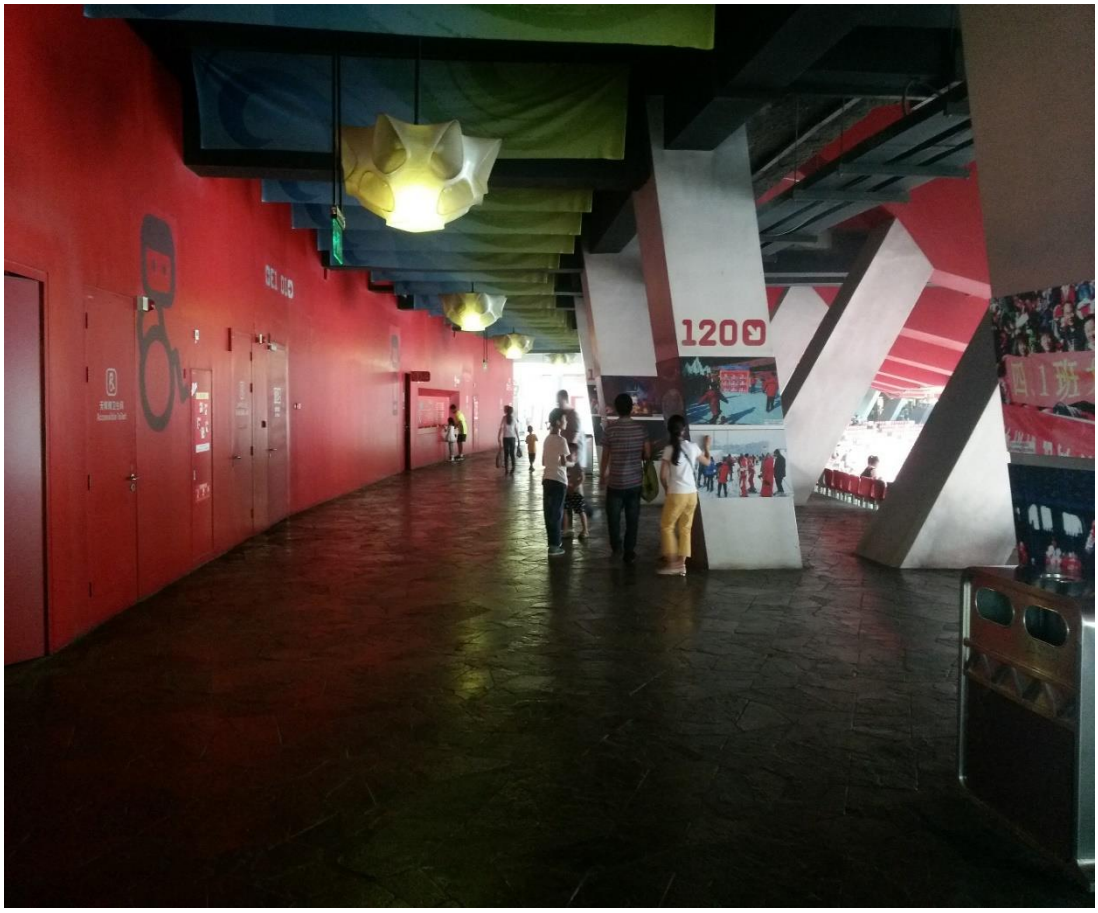
citizens over 60 can enjoy half price. The disabled and senior people over 70 can enjoy the free visit.

Figure 27 The Bird's Nest gift store

Figure 28 The Bird's Nest closed licensed retail store

Figure 29 The Bird's Nest closed food store

Figure 30 The Bird's Nest restrooms



National Swimming Center (Water Cube) was located near Bird's Nest to its west across the Olympic Boulevard. The staffs working in the Olympic Green put some sunshades on the plaza in order to provide visitors places to relax and avoid the hot sun when I visited Water Cube in the field trip. After 2008 Olympic Games, this stadium was constructed, managed, and operated by Guo'Ao Limited Liability Company. Water Cube had five floors including the basement first floor. Olympic competition hall, warm-up pool, and Water Cube Aquatic Park were located in the basement first floor and the first floor. A shopping mall and some restaurants were located in the second floor and third floor. Water Cube Quest Museum, Beijing Olympic Swimming exhibition, and Water Drop Theater are located in the fourth floor. The ticket price for Water Cube is 50 Chinese dollars[43] per person. Children, students,

[43] About 8 US dollars

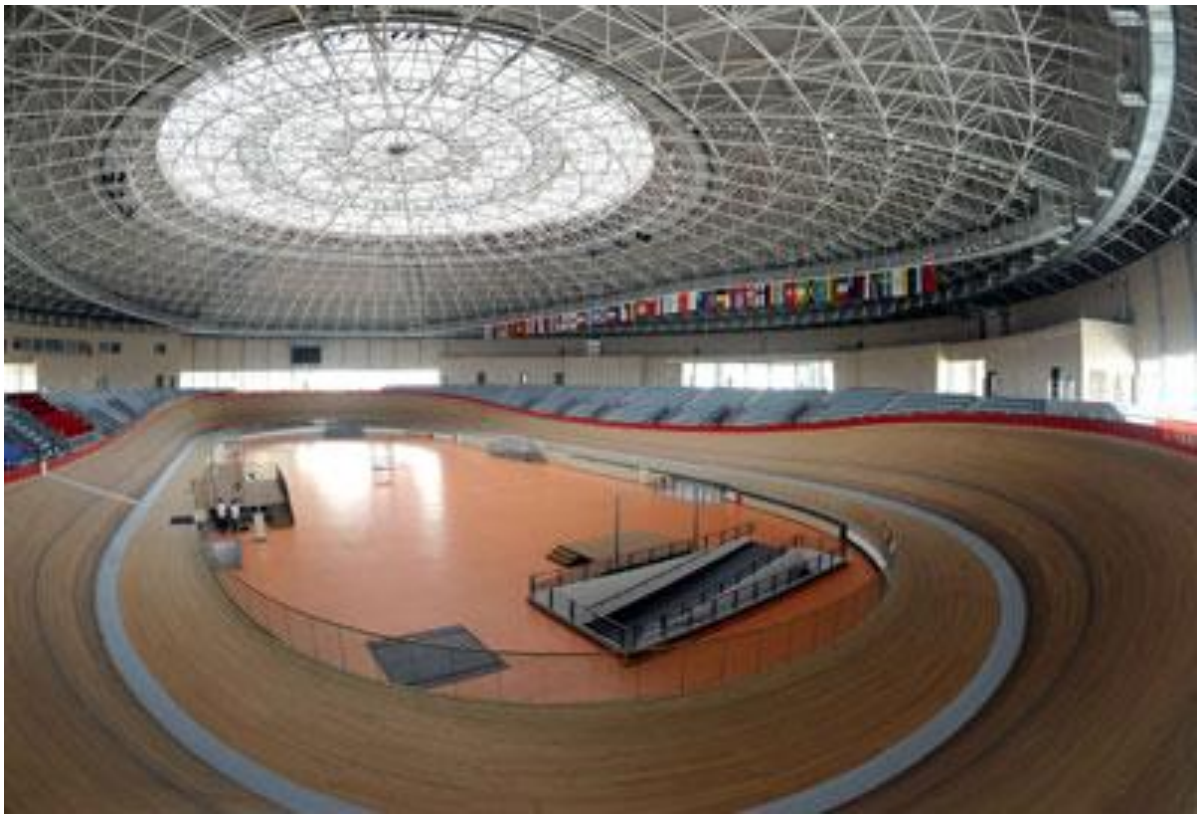
soldiers served in the army, and senior citizens over 60 can enjoy half price. The disabled and senior people over 70 can enjoy the free visit.

After the Games, the Water Cube Aquatic Park was built in the Water Cube. Some local residents believed that the ticket price was high. The ticket price for Water Cube Aquatic Park was 260 Chinese dollars[44] per person. This was a children's water park. "Boys and girls love this water park," said by a staff working in the Olympic Green, "it is very exciting inside. We have the wave pool just like being in the ocean. You can also enjoy the food and drink inside. The price is a little bit high for our normal citizens. I have worked there for years and I haven't been there before because I think the price is expensive. I used to take my son to visit Beijing Fuguo Aquatic Work. It is not as good as Water Cube Aquatic Park but it is much cheaper."

Laoshan Velodrome was considered to be not reused well after the Games. It was located in Shijingshan district, the western side of Beijing. This stadium hosted all the cycling competitions during the Games. It was used as the training center for national cycling team after the Olympics.

[44] About 41 US dollars

Figure 31 Laoshan Velodrome



Source:
http://www.chinadaily.com.cn/olympics/images/attachement/jpg/site1/20080728/0013729ece6b09f7b8f063.jpg

Laoshan Velodrome was a professional cycling racing stadium. It was very hard for amateurs to ride cycles on such sloped tracks. Some tracks were so steep that the slopes were more than forty degrees. Even some professionals may get injured on these steep track at the high speed. As a result, only Chinese national cycling team was still using some part of Laoshan Velodrome after the Games. Local residents and visitors cannot use this stadium because they lack the professional skills. The majority part of the stadium was nearly abandoned now. Some open-space areas were even occupied by a neighboring driving school. Beijing government cannot get any profits from this stadium. The following figure showed the current reuse situation of Laoshan Velodrome.

Figure 32 abandoned Laoshan Velodrome after the Games

Source: http://blog.qq.com/qzone/622008832/1342541599.htm

5.1.2 The social equitable dimension of Beijing Olympic Stadiums and facilities

Though traditionally sustainable development has focused on balancing economic development and environmental protection, social equity has increasingly been recognized as the missing concept in the picture (Campbell 1996; Jepson 2001; Cohen and Preuss 2002). In order to measure social equitable usage of Olympic stadiums, I used SEI (Social Equitable Index) in this paper.

Transportation situation was an important indicator to measure whether Olympic Stadiums were sustainable in the social equitable dimension. Convenient transportation situation can help local residents and visitors go to these stadiums easily, which can make them visit Olympic stadiums frequently. The following table showed the detailed transportation situation of each Olympic stadium. These three criteria can represent the

transportation situation of these Olympic stadiums.

In order to measure the distance from an Olympic stadium to Tiananmen as well as the distance from an Olympic stadium to its nearest subway station, I used Measure Tool from the toolbar of Baidu Maps[45].

Table 20 the detailed transportation situation of each Olympic stadium

Stadium's Name	Distance from this stadium to Tiananmen[46] (km)	Is this stadium located in the populated urban area?[47]	Distance from this stadium to its nearest subway station (km)
National Stadium (Bird's Nest)	11.2	Yes	0.68
National Swimming Center (Water Cube)	11.3	Yes	0.68
Olympic Tennis Center	11.9	Yes	0.86
Yingdong Swimming Center	10.3	Yes	0.90
National Indoor Stadium	11.2	Yes	0.68
Beijing Workers' Stadium	7.8	Yes	0.90
Beijing University of Technology Gymnasium	11.7	Yes	1.60
China Agricultural University Gymnasium	13.8	Yes	3.40
University of Science and Technology Beijing Gymnasium	13.1	Yes	2.40
Beijing University of Aeronautics and Astronautics	14.6	Yes	1.50

[45] A software to show China domestic map

[46] Tiananmen is the geographic center of Beijing. The distance from a stadium to Tiananmen can represent whether this stadium is located in the central urban area or not.

[47] Beijing populated urban area includes Dongcheng, Xicheng, Chaoyang, Handian these four districts

Table 20 (cont'd)

Peking University Gymnasium	17.2	Yes	0.37
Beijing Institute of Technology Gymnasium	15.9	Yes	1.70
Capital Gymnasium	12.0	Yes	4.00
Wukesong Stadium	12.5	Yes	0.85
Fengtai Softball Palestrae	17.0	No	6.10
Shunyi Olympic Water Park	69.3	No	11.00
Laoshan Velodrome	17.5	No	1.30
Beijing Shooting Range CTF	25.8	No	4.10

From the above table, people can find that the distance from the majority of Olympic stadiums to Tiananmen, the geographic center of Beijing, was approximately 10 kilometers. The distance from Shunyi Olympic Water Park to Tiananmen was the longest, approximately 69.3 kilometers. The distance fromn Beijing Workers' Stadium to Tiananmen was the shortest, about 7.8 kilometers.

Fengtai Softball Palestrae, Shunyi Olympic Water Park, Laoshan Velodrome, and Beijing Shooting Range CTF were not located in the populated urban area, which meant that it was hard for most population in Beijing to visit these four Olympic stadiums.

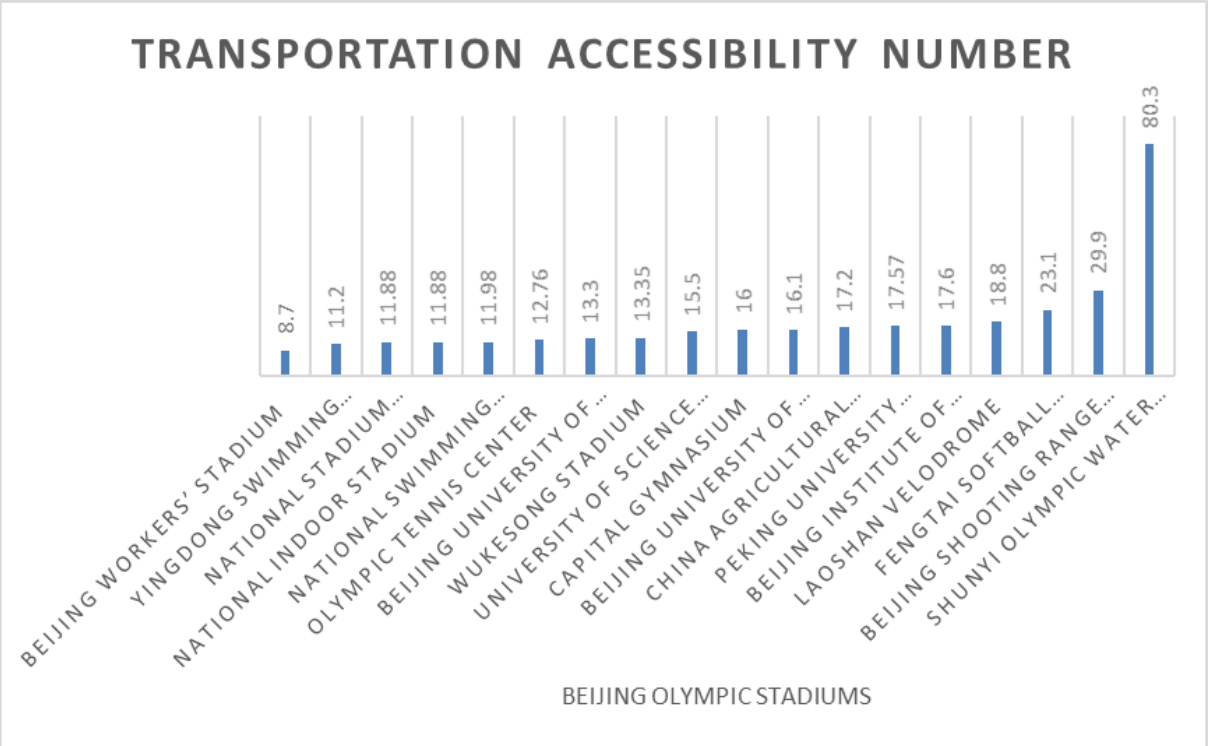
The stadiums located in the Olympic Green was close to subway station including Olympic Green subway station and Olympic Forest Park subway station. The distance from these stadiums to their nearest subway station was within 1,000 meters. In addition, Beijing Worker's Stadium and Wukesong Stadium were also close to the subway stations. The distance from Shunyi Olympic Water Park to its nearest station was the longest,

approximately 11,000 meters.

In order to calculate the social equitable index, this thesis used a sustainable index to describe whether this Olympic stadium was sustainable reused in social equitable aspect after the Games or not.

Firstly, I added the distance from a stadium to Tiananmen and the distance from a stadium to its nearest subway station together because these two criteria can represent the transportation accessibility. The longer this number is, the worse the transportation accessibility of this stadium is. From the following figure, Beijing Workers' Station was the best in transportation accessibility dimension. Shunyi Olympic Water Park was the worst.

Figure 33 Transportation Accessibility number of each Olympic stadium



Then, since the largest transportation accessibility number was the minimum number, the minimum value was 80.3. The maximum value was 8.7. I used the following formula to calculate transportation accessibility index:

TAI = $[\log_{10}(TAN) - \log_{10}(80.3)] / [\log_{10}(8.7) - \log_{10}(80.3)]$. (TAN means

Transportation Accessibility Number)

The following figure showed the TAI (Transportation Accessibility Index) of each Olympic stadium. The range of the index number was from 0 to 1. The larger the number was, the most sustainable this stadium was in transportation dimension.

Table 21 the Transportation Accessibility Index of each Olympic stadium

Stadiums' Names	Transportation Accessibility Index
National Stadium (Bird's Nest)	0.86
National Swimming Center (Water Cube)	0.85
Olympic Tennis Center	0.82
Yingdong Swimming Center	0.89
National Indoor Stadium	0.86
Beijing Workers' Stadium	1.00
Beijing University of Technology Gymnasium	0.81
China Agricultural University Gymnasium	0.69
University of Science and Technology Beijing Gymnasium	0.74
Beijing University of Aeronautics and Astronautics stadium	0.72
Peking University Gymnasium	0.68
Beijing Institute of Technology Gymnasium	0.68
Capital Gymnasium	0.73
Wukesong Stadium	0.80
Fengtai Softball Palestrae	0.56
Shunyi Olympic Water Park	0.00
Laoshan Velodrome	0.65
Beijing Shooting Range CTF	0.44

Based on the above index, Beijing Workers' Stadium was the most sustainable Olympic stadium reused in transportation dimension after the Games. Shunyi Olympic Water Park was the most unsustainable Olympic stadium in transportation dimension.

Ticket price was also an important indicator to measure whether Olympic Stadiums were sustainable in the social equitable dimension. The following table showed the ticket price of

each Olympic stadium in 2014. Since usually the ticket price was divided into several different level, the price of each level was also different. The price adopted in following table was the lowest price which can make normal visitors entered the stadiums but not enjoyed all the facilities inside.

Besides, the price of some stadiums were calculated by hours such as Olympic Tennis Center and so on. The price adopted in following table was the price for one hour. \

In addition, some stadiums were not open to the public at ordinary time. For example, National Indoor Stadium was only open to the public when it hosted some activities. The price of these stadiums were keep blank. These stadiums can be considered unsustainable in social equitable dimension.

Moreover, some Olympic Stadiums located in the University Area had different charging standard towards local students and visitors from other places. For example, students only need 30 RMB to enter Beijing University of Technology Gymnasium to play badminton but normal visitors need 40 RMB. The price adopted in following table was the price which can make normal visitors entered these stadiums.

Table 22 ticket price of each Olympic stadium in 2014

Stadiums' Names	Ticket Price (RMB[48])	Main Activities
National Stadium (Bird's Nest)	50	Traveling
National Swimming Center (Water Cube)	50	Traveling and swimming
Olympic Tennis Center	100	Tennis
Yingdong Swimming Center	50	Swimming
National Indoor Stadium		
Beijing Workers' Stadium	40	Soccer
Beijing University of Technology Gymnasium	40	Badminton
China Agricultural University Gymnasium	60	Badminton
University of Science and Technology Beijing Gymnasium	30	Badminton and table tennis
Beijing University of Aeronautics and Astronautics stadium	50	Badminton and table tennis
Peking University Gymnasium	60	Badminton, basketball, and table tennis
Beijing Institute of Technology Gymnasium	40	Badminton and table tennis
Capital Gymnasium	100	Badminton, basketball, and table tennis
Wukesong Stadium		
Fengtai Softball Palestrae		
Shunyi Olympic Water Park	20	Water sports
Laoshan Velodrome	30	Cycling
Beijing Shooting Range CTF	50	Shooting

Also, I used the following formula to calculate the entrance price index:

$$\text{EPI} = [\log_{10}(Ticket\ Price) - \log_{10}(100)] \,/\, [\log_{10}(20) - \log_{10}(100)]$$

[48] Chinese dollars

Table 23 the Entrance Price Index of each stadium

Stadiums' Name	Entrance Price Index
National Stadium (Bird's Nest)	0.43
National Swimming Center (Water Cube)	0.43
Olympic Tennis Center	0.00
Yingdong Swimming Center	0.43
National Indoor Stadium	
Beijing Workers' Stadium	0.57
Beijing University of Technology Gymnasium	0.57
China Agricultural University Gymnasium	0.32
University of Science and Technology Beijing Gymnasium	0.75
Beijing University of Aeronautics and Astronautics stadium	0.43
Peking University Gymnasium	0.32
Beijing Institute of Technology Gymnasium	0.57
Capital Gymnasium	0.00
Wukesong Stadium	
Fengtai Softball Palestrae	
Shunyi Olympic Water Park	1.00
Laoshan Velodrome	0.75
Beijing Shooting Range CTF	0.43

From the above table, Shunyi Olympic Water Park was the most sustainable Olympic stadium in entrance price dimension. The main reason was this water park was far away from the center of Beijing. Low entrance price can attract more visitors from Beijing.

In order to calculate SEI (Social Equitable Index), I used the following formula:

$$\text{SEI} = \text{TAI} \times \frac{1}{2} + EPI \times \frac{1}{2}$$

The following table showed the SEI of each Olympic stadium.

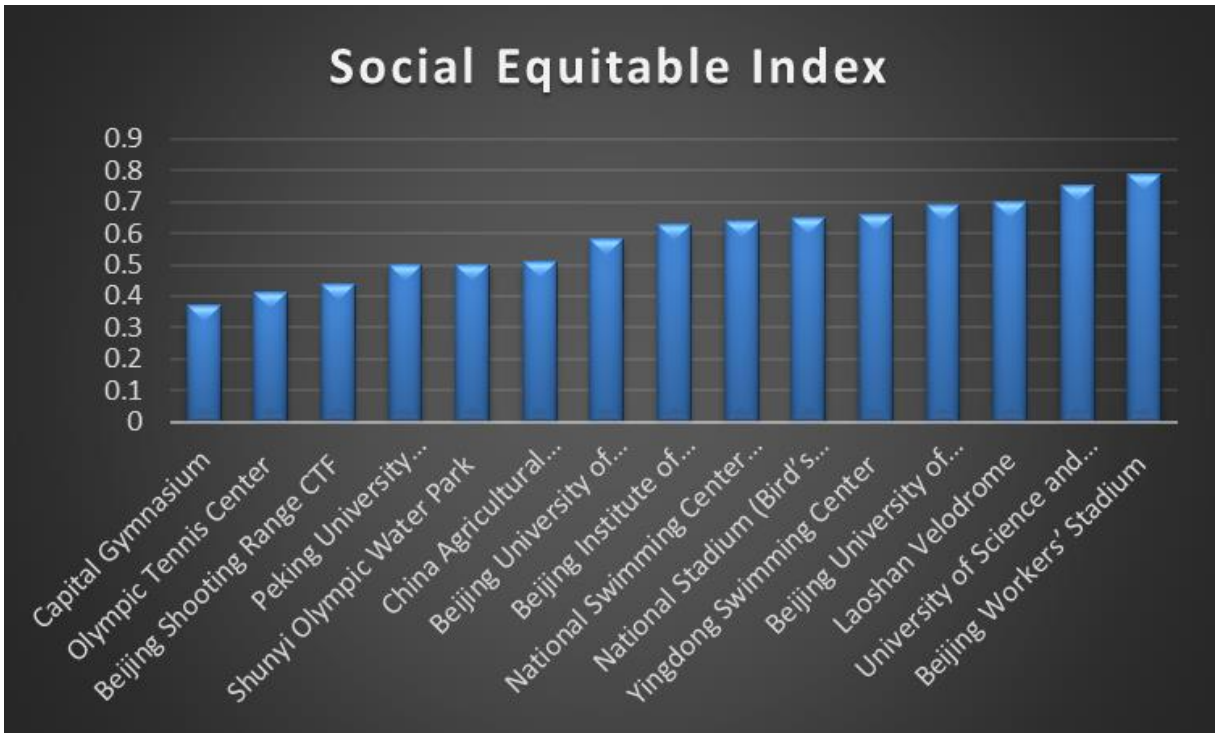
Table 24 the Social Equitable Index of each stadium

Stadiums' Name	Social Equitable Index
National Stadium (Bird's Nest)	0.65
National Swimming Center (Water Cube)	0.64
Olympic Tennis Center	0.41
Yingdong Swimming Center	0.66
National Indoor Stadium	
Beijing Workers' Stadium	0.79
Beijing University of Technology Gymnasium	0.69
China Agricultural University Gymnasium	0.51
University of Science and Technology Beijing Gymnasium	0.75
Beijing University of Aeronautics and Astronautics stadium	0.58
Peking University Gymnasium	0.50

Table 24 (cont'd)

Beijing Institute of Technology Gymnasium	0.63
Capital Gymnasium	0.37
Wukesong Stadium	
Fengtai Softball Palestrae	
Shunyi Olympic Water Park	0.5
Laoshan Velodrome	0.70
Beijing Shooting Range CTF	0.44

Figure 34 the Social Equitable Index of each Olympic stadiums



From the above figure, Beijing Workers' Stadium can be considered to be the most sustainable Olympic stadium in social equitable dimension. In addition, University of Science and Technology Beijing Gymnasium, Laoshan Velodrome, Beijing University of Technology Gymnasium, Yingdong Swimming Center, National Stadium (Bird's Nest), and National Swimming Center (Water Cube) can be considered reused well in social equitable dimension after the Games.

On the contrary, Capital Gymnasium, Olympic Tennis Center, and Beijing Shooting Range CTF can be considered not sustainable in social equitable dimension after the Games. Besides, National Indoor Stadium, Wukesong Stadium, and Fengtai Softball Palestrae were not reused well in this dimension because local residents as well as visitors cannot enjoy these three Olympic stadiums since all of which were not open to the public after the Olympics.

Beijing Workers' Stadium was located in Beijing prosperous urban area, very close to the old town. As a result, it was very convenient for people who wanted to visit this stadium. There were two subway station close to Beijing Workers' Stadium: East Sishitiao station and Tuanjie Lake station. Line No.2 and line No.10 can bring people to Beijing Workers' Stadium. Because of a large number of funds and subsidies from Beijing government, the subway in Beijing was developed and efficient, and even the longest journey will cost just 2 Chinese dollars[49]. There were three bus stations near Beijing Workers' Stadium. Seventeen bus lines can take people to visit this stadium[50]. As a result, it was convenient and affordable to visit Beijing Workers' Stadium by public transportation.

[49] 2 Chinese dollars= 0.3 US dollars

[50] Beijing Bus System official website http://www.bjbus.com/home/index.php

Beijing Workers' Stadium covered an area of 0.4 million square meters. About 0.14 million square meters were grassland for playing ball games and having fun. There were hundreds of small football fields inside or around Beijing Workers' Stadium which were open to the public. The entrance price for the normal football field was 40 Chinese dollars[51] per hour. It was not expensive if several friend go there and share the price. The entrance ticket price for some professional natural grass field was 800 Chinese dollars[52] per hour. In addition, some grassland was for people to visit and have fun as the small urban grassland. These grassland can attract a large amount of local residents and visitors. Besides, Beijing Workers' Stadium also had some badminton courts, table tennis tables, and basketball fields inside. All the entrance ticket price for these small sports courts were 40 Chinese dollars per hour[53]. Every local residents and visitors can enjoy these grassland and facilities with affordable prices. The post-Olympic usage of Beijing Workers' Stadium was widely considered to be good and sustainable in social equitable dimension.

Figure 35 the football field around Beijing Workers' Stadium

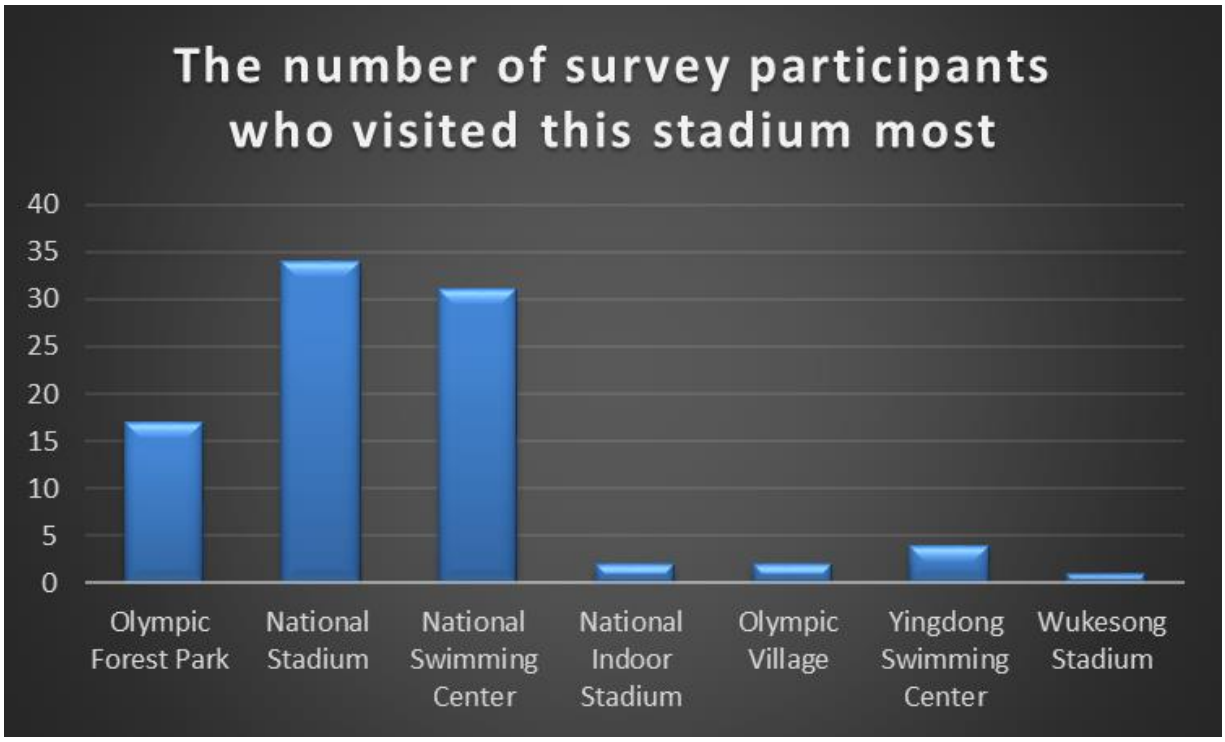
Figure 36 the badminton court inside Beijing Workers' Stadium

Source: **http://yundongxiuxian.huangye88.com/xinxi/18300265.html**

[51] 40 Chinese dollars= 6.35 US dollars
[52] 800 Chinese dollars= 126.98 US dollars
[53] China Xinhua Press http://news.xinhuanet.com/sports/2005-09/29/content_3560898_1.htm

National Stadium (Bird's Nest) and National Swimming Center (Water Cube) were all located in the Olympic Green in Beijing populated urban area. It was convenient to visit these two famous Olympic stadiums by subway. Olympic Green subway station was located at the entrance gate of the Olympic Green. The distance from these two stadiums to Olympic Green subway station was within 1,000 meters. Olympic Green was not far from the old town, which only cost visitors 30 minutes by driving. Although there was no free public parking lots nearby, the parking price was affordable according to the results of interviews with the visitors during the field trip.

Figure 37 Question #16 which facilities you visit or use most (multiple choice)



Question #16 investigated which stadium or facility survey participants visit or use most. According to the above result, the majority of survey participants answered they visited National Stadium (Bird's Nest) and National Swimming Center (Water Cube) most. This result of questionnaire indicated that National Stadium (Bird's Nest) and National Swimming Center (Water Cube) were still be used by many residents and visitors after the Olympics.

These two stadiums were considered to be used over average after the Games.

There was a reason that why approximately 71% survey participants said they visited National Stadium (Bird's Nest) and National Swimming Center (Water Cube) most was that these two stadiums were so famous which influenced their results because nearly half of whom were visitors from different cities. Unlike the other Olympic stadiums such as Beijing Workers' Stadium, people cannot doing sports in National Stadium. Instead, the main reason to visit this stadium was traveling. Many survey participants believed that National Stadium should provide them with some places for sports games and have fun in the interviews during the field trip.

5.1.3 Recommendations for Beijing Olympic Stadiums and Facilities

Based on the results of questionnaire and the observation of the author, I had some recommendations for Beijing Olympic stadiums and facilities.

- Olympic stadiums should be mix-used

In order to improve economic dimension of Olympic venues, the venues were supposed to be mix-used after the Games since the majority of which are huge and cover a lot of room in order to make money from themselves and be responsible for their own profit and loss. Stadiums should be divided into several places. Each place has its own function. Some places can host sports games or art performance. Some places can be offices. Some places can be rent out to as malls, restaurants, or hotels in order to make money from rent fee and attract visitors.

Veltins Area in Gelsinkirchen, Germany, was considered as a good mix-used stadium.

This stadium was owned and operated by FC Shalke 04. This stadium included a soccer field for Shalke Football team. Meanwhile, it also included some halls for hospitals, three restaurants and cafes, for a wide range of sports events including handball, American football, ice hockey, and so on. Every year this stadium hosted 25-30 major international events and attracted approximately 1.5 million people. (Von Gerkan Marg, 2013)

Based on the current reuse situation of Beijing Olympic venues such as National Stadium, a large number of room was wasted after the Games. Some room can be rent out as restaurants, cafes, convenient stores, malls, or hotels. In addition, there were so many restroom which occupied a lot of room in National Stadium. It didn't need to have a lot of restrooms in usual time because the amount of these restrooms was way beyond the visitors' need based on the author's observation. Some restrooms can be changed as normal rooms and be rent out in order to make profits. During the competition day, the staffs in National Stadium can use some portable toilets to meet people's need. Portable toilets didn't need so many room. As a result, a large number of room can be saved to be rent out to make profits for local government in order to achieve sustainable usage in economic dimension.

- Developing a post-Olympic usage council to improve public participation

Developing a post-Olympic usage council has great significance. This council can bring together diverse stakeholders to study the current usage of each Olympic stadiums and offer recommendations for some policies change. It can attract local students, residents' representatives, and scholars studying on post-Olympic usage, government officers, non-government organization members, and planners together to discuss the whether the current reuse situation of each Olympic stadium was good and give recommendations to the

reuse policies. The foundation of post-Olympic usage council can address the gap between planning and implementation of policy.

Figure 38 types of mix-used development functions

Source: http://www.slideshare.net/jessesouki/tod-framework-10-14-h-rule

In addition, the establishment of post-Olympic usage council can also improve the public participation in post-Olympic usage of venues. Today the majority of Olympic venues were managed by a state-owned cooperation called Guo'Ao Group. The economic data of Olympic venues were not allowed to be published according to government's regulations. Local residents cannot know how these stadiums managed and whether government and residents can got economic benefits from these venues after the Games. The foundation of post-Olympic usage council can dramatically improve the public participation. The diverse stakeholders in this council can influence local government to make the whole economic data

published and advocate their own voices.

- Improving the transportation accessibility situation and strengthening the linkage with people in the surrounding areas

The improvement of transportation accessibility situation of Olympic stadiums can improve the usage in social equitable dimension. The convenient transportation can attract more visitors and make these visitors enjoyed the legacy of the Games. In order to improve the transportation accessibility situation of the Olympic stadiums, local government should build more bus stops near the venues to reduce the time from this Olympic venue to its nearest subway station. Moreover, local government should also enlarge the public parking lots around the Olympic venues in order to make the drivers more convenient to visit Olympic venues.

In addition, local government should also strengthen the linkage between Olympic venues and the people living around the venues. Olympic venues should offer local residents places to exercise as well as service after the Games. In order to strengthen the linkage with local people, Olympic venues were supposed to decrease the entrance ticket price for people and students living and studying in the surrounding areas.

5.2 Findings and Discussions of Olympic Forest Park

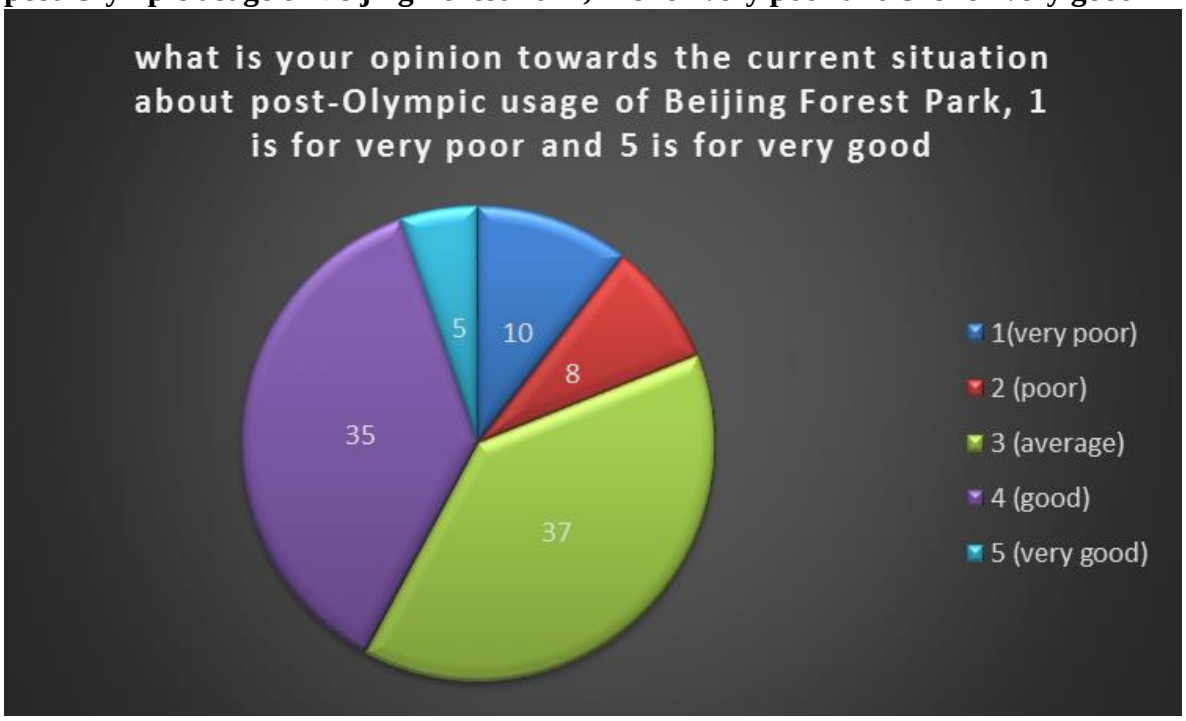
The results of the questionnaires was an important feedback which can represent survey participants' opinions from the local residents and visitors towards the Forest Park. Around 95 questionnaires including 31 questions focusing on the three dimensional nature of sustainable development (economic, social equitable, and environmental) of the Olympic Forest Park were done during the field trip in Beijing. The questions on Forest Park mainly focused on the environmental and social equitable dimensions. I found that Olympic Forest Park can bring benefits to Beijing environment but cannot solve all the environmental problems in recent years. In addition, the Forest Park can provide local residents and visitors a huge urban park to have fun and relax. However, it still need to do a lot to improve its reuse situation in social equitable dimension.

Before I present details of findings related to the environmental and social equitable dimensions, I will introduce findings on general opinions of sustainable usage of the park. First, only a few survey participants think that Olympic Forest Park was sustainable used after the Olympic Games, comparing with other facilities, according to the survey. In question #9 "Which stadium or facility do you think is sustainable used after the Games", 8 survey participants, or around 7.6 percent, answered "Olympic Forest Park".

Second, however, the majority of the participants consider the sustainable usage of the park was about or above average. In question #12 "What is your opinion towards the current situation about post-Olympic usage of Beijing Olympic Green (1 is for very poor and 5 is for very good)", survey participants were supposed to use number 1 to 5 to express their attitudes towards the stadiums and facilities in the Olympic Green, the majority of the who used

number 3, which was average, to answer this question. About 81.5% survey participants chose 3 or the number greater than 3 to represent their opinions, which means that the overwhelming majority of who believed the current usage situation of Olympic Forest Park was above average. 37 survey participants, about 38.95 percent, said their opinions towards the post-Olympic sustainable usage of Olympic Forest Park were just average.

Figure 39 Question #12 what is your opinion towards the current situation about post-Olympic usage of Beijing Forest Park, 1 is for very poor and 5 is for very good



5.2.1 Environmental dimension of post-Olympic sustainable usage of the Forest Park

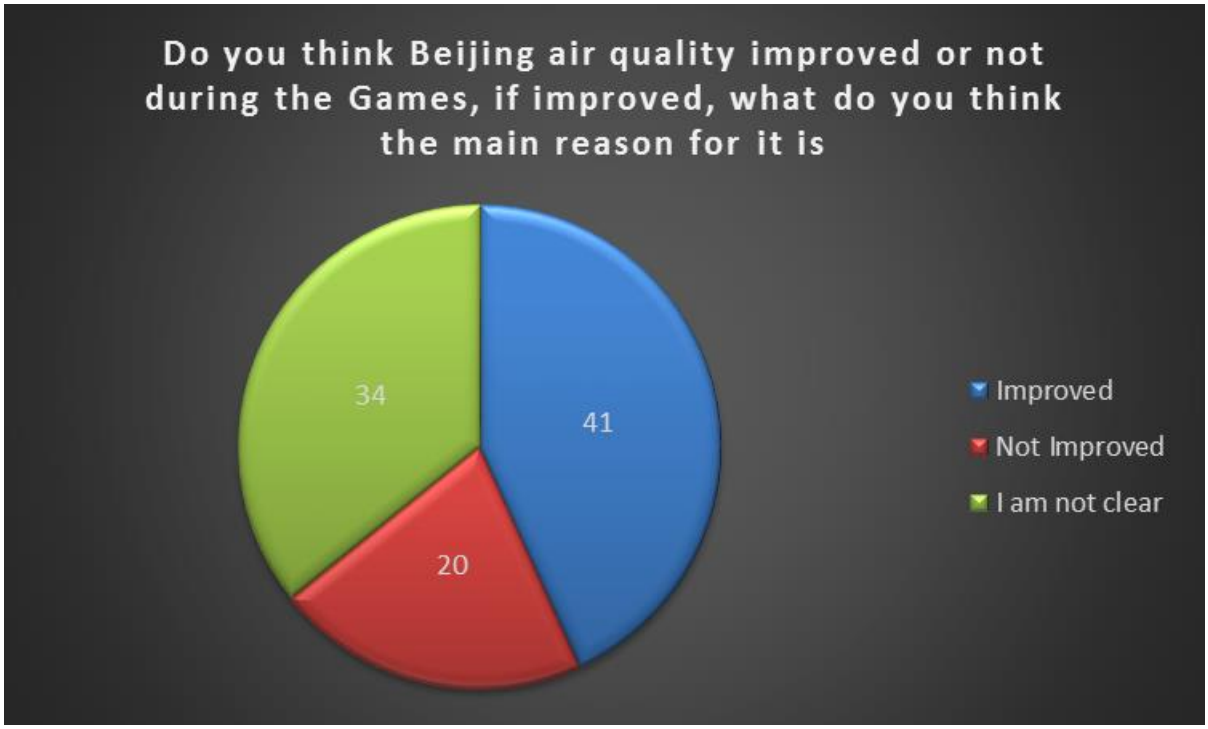
In the questionnaire, question #14 to question #19 investigated survey participants' attitudes towards whether they believed the Forest Park can bring benefits to Beijing urban environment. These questions paid attention to the environmental dimension of sustainable usage of Beijing Forest Park after Games. This part described survey participants' attitudes towards the environmental dimension of post-Olympic sustainable usage of Olympic Forest Park including the air quality and water quality, stated some findings based on survey

participants' feedbacks. All the statements were described by chronological order from the period during 2008 Games to the current period.

The air quality of Beijing were significantly improved during the Olympic Game period due to the government policies, such as relocation of certain industries, restriction of driving and construction, and tree planting. However, most participants were not satisfied with the current air and water quality of Beijing in the post-Game period, although the Forest Park seems to contribute to the improvement of air quality in Beijing.

Most participants considered air quality in Beijing improved during the Games, according to the answers to question #15. 41 survey participants answered the air quality of Beijing improved during the Olympic Games 2008. Only 20 participants said the air quality didn't improve during the period of Olympics. The rest people answered they were not clear. The following figure showed the result of this question.

Figure 40 Question #15 Do you think Beijing air quality improved or not during the Games, if improved, what do you think the main reason for it is



Almost all the survey participants who said the air quality in Beijing improved during the period of Olympic Games believed that the government policies played a decisive role in improving the local air quality. One anonymous professor pointed out that in order to improve the air quality during the Olympic period, the local government accelerate the movement of industries relocation. Some polluted industries had to move to the suburban area or other satellite cities in order to readjust Beijing industrial structure and reduce pollution in the urban area. For example, Beijing Shougang Group was the largest iron and steel enterprise in Beijing urban area. It moved to Chaofeidian, another city located in Hebei province which was two hours' drive from Beijing. The relocation of Beijing Shougang Group was planned by Beijing government several years ago and accelerated due to the coming of 2008 Olympic Games[54].

Some participants also argued that during the period of Olympic Games, the "odd-and-even license plate rule" adopted by local government was also one of the reason why they believed the air quality improved during the Olympics. The odd-and-even license plate rule allowed only the vehicles with odd license plates on the road in odd number date and the vehicles with even license plate on the road in even number date. According to China Daily, the major air pollutants, such as carbon monoxide, carbon dioxide and particulate matter from vehicles have dropped by 20% during the Olympic period due to the "odd-and-even license plate rule".

[54] According to Jiming Zhu, the president of Beijing Shougang Group, Beijing Shougang Group brought about 9 billion Chinese dollars (about 1.4 billion US dollars) to local society in 2004. (http://finance.sina.com.cn/g/20050405/08201487690.shtml) The relocation of Beijing Shougang Group began from 2005. It finished in 2010. The most constructions were done before 2008 Olympic Games. Beijing government paid about 60 billion Chinese dollars (about 9.5 US dollars) building a new industry area for Beijing Shougang Group in Chaofeidian. In addition, local government also was supposed to help Beijing Shougang Group train and place the laid-off workers caused by the relocation of this industry. The new industry can create 200 billion Chinese dollars (about 31.75 billion US dollars) to the society every year. Beijing government can also get some part of it, according to Jiming Zhu.

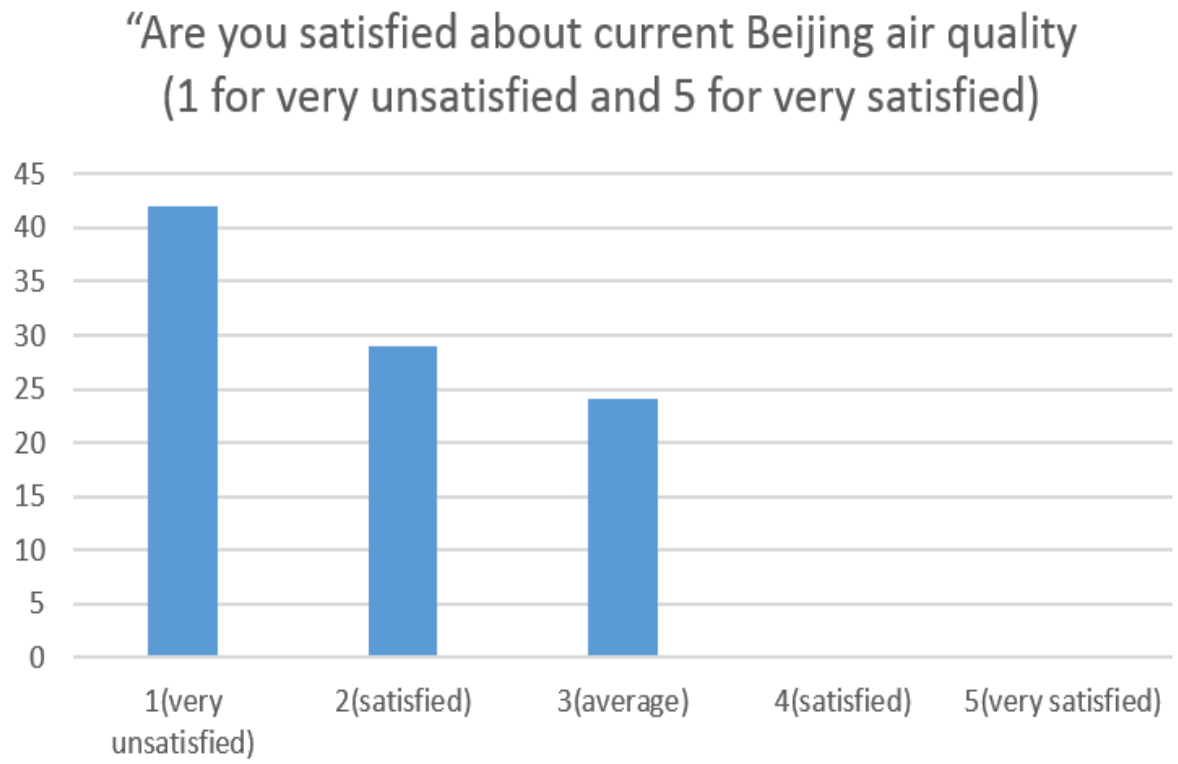
Besides, some participants said no construction in Beijing during that very period and tree planting movement, which were regulated by the government, also were the reasons. As a result, the construction of Beijing Olympic Forest Park did improve the air quality during the Olympic Games. However, the policies such as the "odd-and-even license plate rule" and so on also played an important role in improving Beijing air quality during the Games.

Question #14, question #16, and question #17 investigated survey participants' opinions towards Beijing air quality during the period after the Olympics. As the largest urban park and "… one of the most important Olympic legacy from the Games[55]" (Shi'Ao LLC, 2009) in Beijing urban area, Olympic Forest Park was expected to improve the air quality in Beijing after the Games.

The majority of survey participants said that they were not satisfied with the air quality after the Games, especially Beijing current air quality. About 44.21% participants said they were very unsatisfied about the current Beijing air quality. Nobody answered that they are satisfied with the current air quality. It can indicate that the air quality problem in Beijing was very serious. Both local residents and visitors expressed their dissatisfaction towards Beijing air quality.

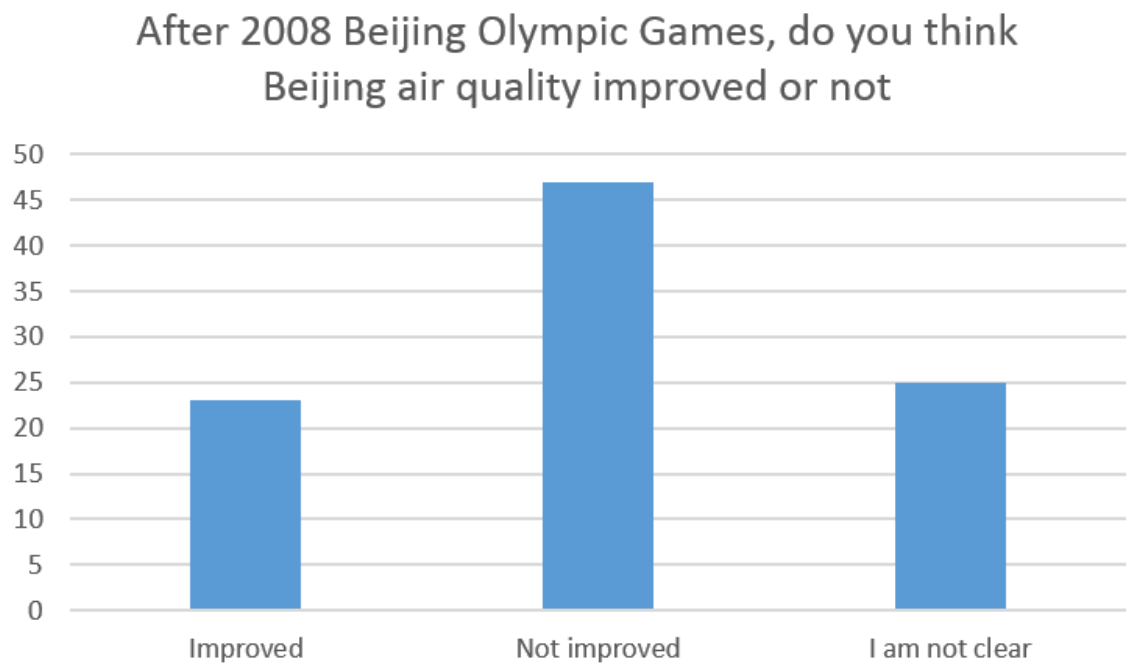
[55] Beijing Olympic Forest Park Official website http://www.bjofp.cn/gyjj/

Figure 41 Question #14 Are you satisfied about current Beijing air quality, 1 for very unsatisfied and 5 for very satisfied



The majority of the survey participants believed the air quality in Beijing area didn't improve after the Games even with the construction of Olympic Forest Park. In question #16 "After 2008 Beijing Olympic Games, do you think Beijing air quality improved or not", about 50% participants said the air quality didn't improve after the Games. Only 24.21% survey participants said the air quality in Beijing improved after the Olympic Forest Park was put into use. The rest of them said they were not clear. The following figure showed the result of this question.

Figure 42 Question #16 After 2008 Beijing Olympic Games, do you think Beijing air quality improved or not



Survey participants' dissatisfaction towards the current situation reflected that the construction of Olympic Forest Park cannot solve the air problems in Beijing completely. Olympic Forest Park was put into use from August 2008 after the Games. Although it was widely considered as "the green lung of Beijing", the air quality of Beijing still reduced during recent years.

Over the half of the survey participants answered that the Forest Park can bring benefits to Beijing air quality. In question #17 "Do you think Beijing Olympic Green and its Forest Park can improve Beijing air quality or not", about 62.1% survey participants believed that Olympic Forest Park can improve Beijing air quality. The result can represent people's opinions that the Forest Park can bring benefits to Beijing urban environment.

The reasons why the air quality in Beijing was poor and even became worse during

recent years was complicated. Most people and scholars believed that pm10 and pm2.5 were the main reasons that caused the poor air quality and smog weather in today's Beijing appeared frequently in autumn or winter.

The Forest Park can reduce the air pollution but cannot solve today's Beijing air problems because the causes of the today's air pollution were diverse, the solution to solve the air problem should also be diverse. Local government had responsibility to adopt other methods such as the relocation of industries and so on to solve today's Beijing air pollution.

The air pollution in Beijing can be divided into two periods: dust pollution and mixed particulate matters pollution. Dust pollution was predominant before about 2005. Then the main pollution in Beijing area was replaced by mixed particulate matters during the period from approximately 2005 till now. There was no exact timeline to separate these two pollutions. Dust pollution still existed in recent years. There were some remarkable differences between these two types of pollutions. The first difference was the time difference. Dust pollution in Beijing usually appeared in the end of the winter and beginning of the spring, for example, February or March. However, mixed particulate matters pollution usually appeared in every autumn and winter. Second of all, these two different pollutions were caused by different reasons. Dust pollution was mainly caused by the sandstorms from Inner Mongolia every spring. Natural reasons played an important role causing dust pollution. Mixed particulate matters pollution was caused by microscopic solid matter suspended in the atmosphere in Beijing area, mainly impacted by human beings' behavior. Thirdly, the sizes of the pollutants were different. The size of the pollutants of dust pollution were large and can be seen by eyes. The size of pollutants of mixed particulate matters pollution were quite small.

The pollutants were invisible. Finally, it is much easier to solve the dust pollution problem. It may cost a large number of money and a long period to abate the mixed particulate matters pollution.

The dust pollution was caused both by nature and human beings. The winter winds from the Eurasian mainland were one of the main reasons to cause the dust pollution. The dusts in dust pollution usually referred to some dirt which can be seen by people's eyes. Beijing was worried by the yellow sandstorms every spring for a long time before 2005. Usually in the end of February every year, the winds from Mongolia plateau brought a mass of sands to Beijing and the surrounding areas because of the Mongolia high pressure. Beijing was in temperate monsoon climate influenced by the turn of the warm and damp summer winds from the Pacific in the summer and the cold and dry winter winds from Mongolia and Siberia in the winter. Every winter the strong cold and dry winds from the Eurasian mainland overwhelmed the week winds from the Pacific and was dominant in all the north part of China, Korea, and Japan. Some winter winds even can reach the western coasts of the USA. During the period from the end of February till March or April, the warm and damp summer winds from the Pacific became stronger and tried to push the winter winds back to Siberia. These two season winds usually struggled for a long time and stopped in Beijing area. The winter winds stayed in Beijing area for quite a while and retreated to Siberia in May or June since it became weaker and weaker. During this period, a mass of sands were brought from Mongolia or Inner Mongolia to Beijing by the winter winds, which caused serious sandstorms every spring.

Dust pollution was also caused by the behavior of human beings. Overgrazing, the

destruction of the grassland, deforestation, and rapid development of coal mining industry were the main causes of the sandstorms from Mongolia. Mongolia and Inner Mongolia once had one of the most beautiful grasslands in the world. During the second half of 20th century, with the rapid development of industries, many grasslands were destroyed and abandoned since they cannot afford too many domestic animals. The land became bare and rocky. Many trees were cut down to meet the demands of the industry. In addition, the development of coal mining industry caused a large number of sands and dirt. With the destruction of the natural plants in Mongolia and Inner Mongolia, the winter winds brought more and more sands every year. The sandstorms became more and more serious.

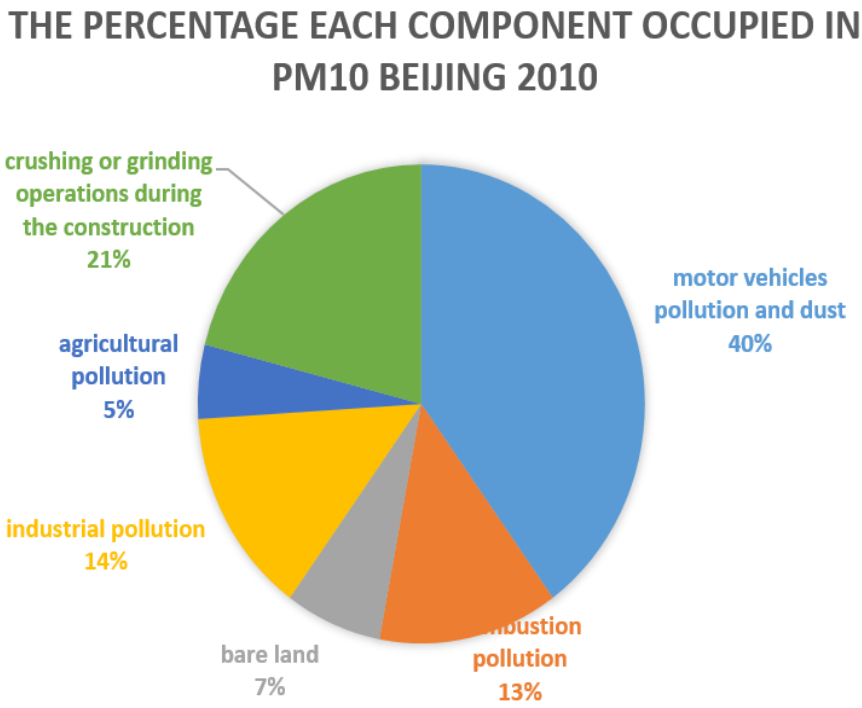
Beijing government sponsored a research and movement called "Blue sky Movement" led by BIEC (Beijing Institute of Environment and Conservation) and Peking University in order to solve the dust pollution appeared every spring from 1998. "Blue Sky Movement" adopted some methods including planting tree in Beijing and the surrounding areas in order to slow down the wind speed and stop the sands from entering Beijing area, reducing the areas of the bare land, relocating some heavily-polluting industries, enlarging the areas of Beijing urban public parks, and even doing some international research with the governments of organizations in Mongolia and Russia. This movement continued for about ten years. It was widely acknowledged to be a success by many scholars and professionals. In this respect, the construction of Olympic Forest Park indeed can abate the dust pollution and improve the air quality.

However, according to the results of the questionnaire, it looked like that the construction of Olympic Forest Park didn't bring significant benefits to Beijing air quality. The reason

why Beijing air problem was so hard to be solved completely was that the pollutant size became more and more small and causes became much more. After 2005, especially during the period from 2011 till now, mixed particulate matters pollution became more serious. (Yingdeng Peng)

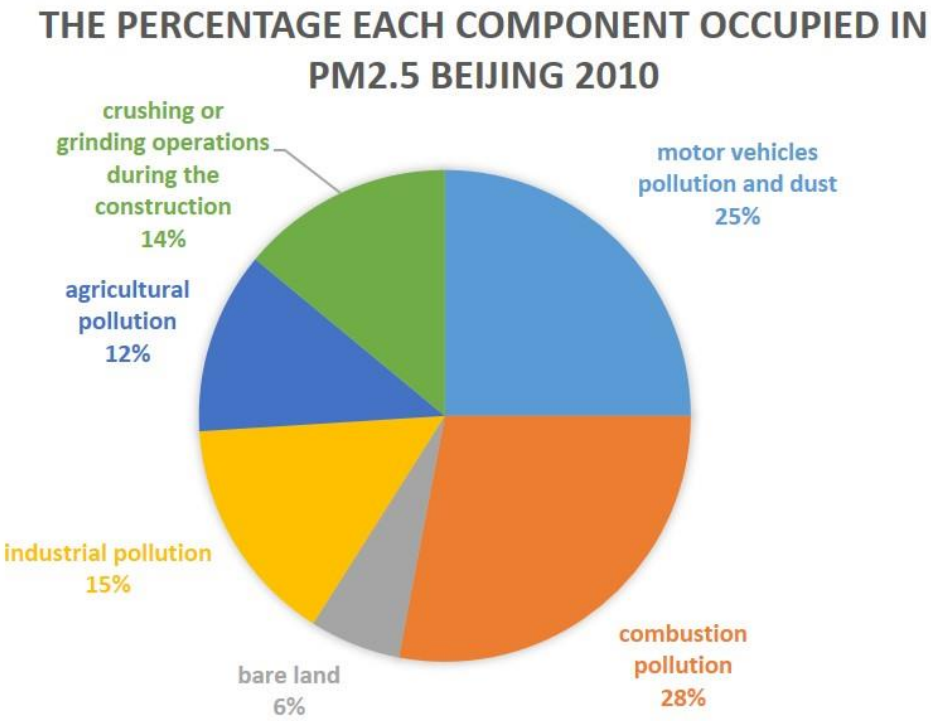
Mixed particulate matters pollution was called “mixed pollution” because the pollutants of this pollution were no single but mixed. It consisted of dirt, pm10, pm2.5 and so on. Particulate matters, also called atmospheric particulate, referred to the particulate less than 2.5 micrometers or between 2.5 and 10 micrometers in diameter. These particulates were too small to be seen by human’s eyes. They can only be detected by electron microscope. These particulates included all types of combustion, motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, some industrial processes, crushing or grinding operations, and dust stirred up by vehicles traveling on roads. The following two figures showed the percentage each component occupied in pm10 and pm2.5 in Beijing, 2010.

Figure 43 the percentage each component occupied in pm10 Beijing 2010



Source: the research on the sources of Beijing pm2.5, Yingdeng Peng, Zhonghua Zhang, 2012

Figure 44 the percentage each component occupied in pm2.5 Beijing 2010



Source: the research on the sources of Beijing pm2.5, Yingdeng Peng, Zhonghua Zhang, 2012

From the above two figures, people can find that the components of pm10 and pm2.5 were complex, which means the causes of the mixed particulate matters pollution were

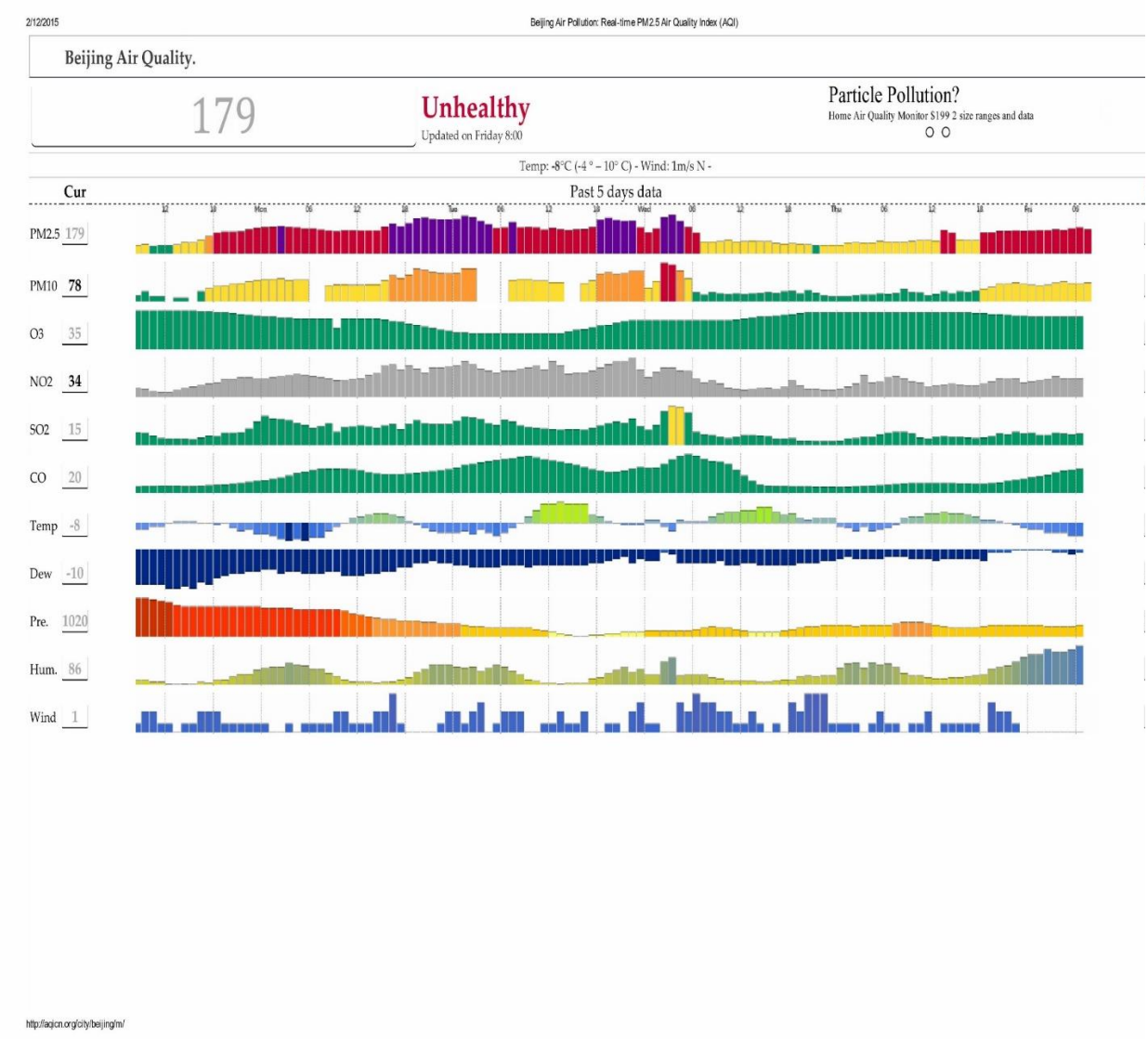
diverse. In pm10, motor vehicle pollution and dust occupied the most percentage which was about 40%. Then crushing and grinding operations during the construction occupied 21%. In pm2.5, combustion pollution occupied the most which was 28%. Then motor vehicle pollution and dust occupied 25%.

Since the causes of the mixed particulate matters pollution were diverse, the solution to solve the air problem should also be diverse. Olympic Forest Park can slow down the wind speed from Mongolia and Siberia and stop the sands from entering Beijing area, which can dramatically abate the dust pollution. The Forest Park did bring benefits to Beijing environment and air quality after 2008 Beijing Olympic Games. According to the annual report made by Shi'Ao cooperation, the operation company of Beijing Olympic Forest Park, it had green land which covered an area of approximately 1181 acres and water which covered an area of approximately 166 acres with about 550,000 arbor trees inside. It can produce approximately 5,208 tons of oxygen and absorb about 4,731 tons of dust every year. It can also dramatically mitigate the urban heat island. The average summer temperature in the Forest Park was five degree cooler than the rest of the city. The average winter temperature in the Forest Park four degree higher than the rest of the city[56]. (Shi'Ao Cooperation)

However, in order to reduce the pollution and improve the air quality in today's Beijing, Beijing government should focus on the sources of the mixed particulate matters pollution. For example, the relocation of high-polluted factory adopted by Beijing government in recent years did reduce the pm2.5 and pm10 in Beijing air quality.

[56] Beijing Olympic Forest Park Official website http://www.bjofp.cn/gyjj/

Figure 45 Beijing Air Quality 2/12/2015



Source: http://aqicn.org/map/beijing/#@g/35.8316/110.7985/4z

The above figure showed the current Beijing air quality. Pm2.5 and pm10 were still high which caused Beijing air quality unhealthy. This was why so many survey participants believed that Beijing air quality didn't improve after 2008 Olympic Games with the construction of Olympic Forest Park.

Figure 46 Beijing Air Quality Index Visual Map

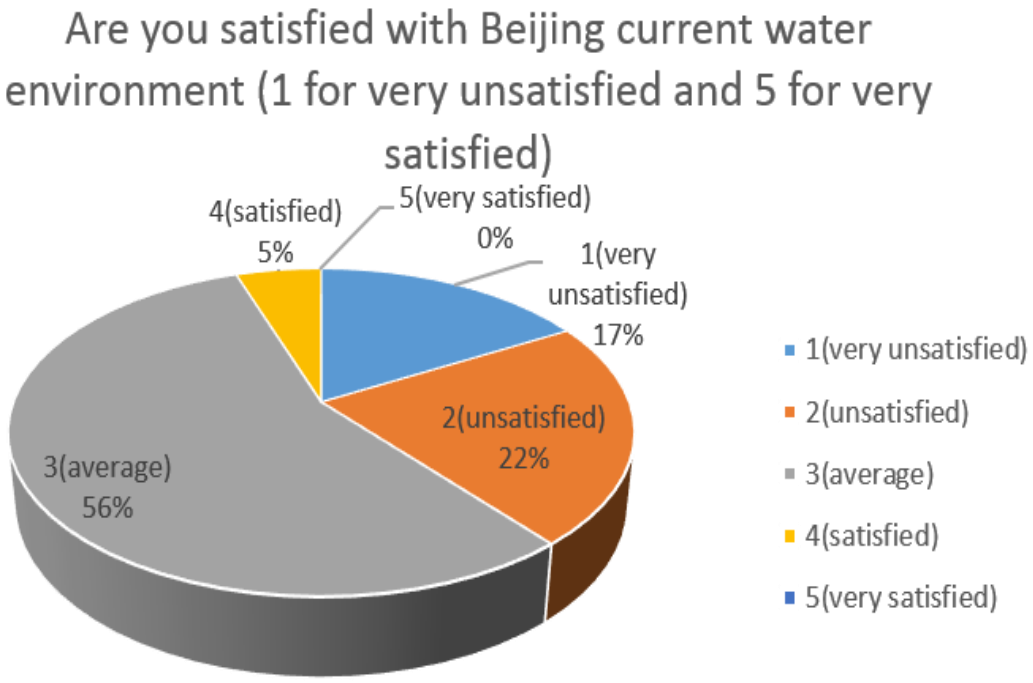
Source: http://aqicn.org/map/beijing/#@g/35.8316/110.7985/4z

From the above picture, people can find that pm2.5 and pm10 were high in all the urban area in Beijing. Beijing Olympic Forest Park didn't reduce the pm2.5 and pm10 in its very area, which indicated that the Forest Park cannot terminate the mixed particulate matters pollution in today's Beijing.

Most survey participants said that they believed Beijing current water environment was average or not good. In question #18 "Are you satisfied with Beijing current water environment (1 for very unsatisfied and 5 for very satisfied)", most survey participants

expressed that they were not satisfied with the current water environment in Beijing. Only five of them chose number 4 to represent they were satisfied with the current water environment. Nobody chose number 5 for very satisfied. The following figure showed the result of this question.

Figure 47 Question #18 Are you satisfied with Beijing current water environment (1 for very unsatisfied and 5 for very satisfied)



The majority of the survey participants answered that Beijing Forest Park can reduce industrial pollution in Beijing. Only 37.89% participants said that Forest Park cannot.

5.2.2 Social equitable dimension of post-Olympic sustainable usage of the Forest Park

Beijing Forest Park was not sustainable reused in social equitable dimension after the Games. Most visitors traveled to there by public transportation. The fact that the park is visited by many people first time indicates that it is not mainly served as a neighborhood park frequently used by surrounding residents. It also implies that Beijing Forest Park is very

accessible by the general public through public transportation.

Question #21, #25, and #26 focused on the social equitable dimension of post-Olympic sustainable usage of the Forest Park. These three questions investigated whether Olympic Forest Park was frequently used by local residents or visitors. Since Olympic Forest Park was positioned and planned as a huge urban public park serving the local residents and visitors after the Olympics, it was expected to provide them with a huge, public space in the urban area by public.

Only a few survey participants answered that they visited the Forest Park frequently. In question #21 "which facilities you visit or use most", only 17 survey participants, about 17.9 percent, answered they visited Olympic Forest Park most. The most selected option was the Bird's Nest. Nearly 45% survey participants said they visited Bird's Nest most. Furthermore, there were 10 survey participants, about 11 percent, said they visited the Water Cube most. Bird's Nest (National Stadium), Olympic Forest Park, and Water Cube (National Swimming Center) were the three most selected Olympic facilities visited by the survey participants.

The reason why most survey participants answered they visit the Bird's Nest most was that over half of the participants were visitors traveling to the Olympic Green or students studying in the university area, most of who tended to visit the Bird's Nest because this stadium was super famous and can be a landmark of the Olympic Green.

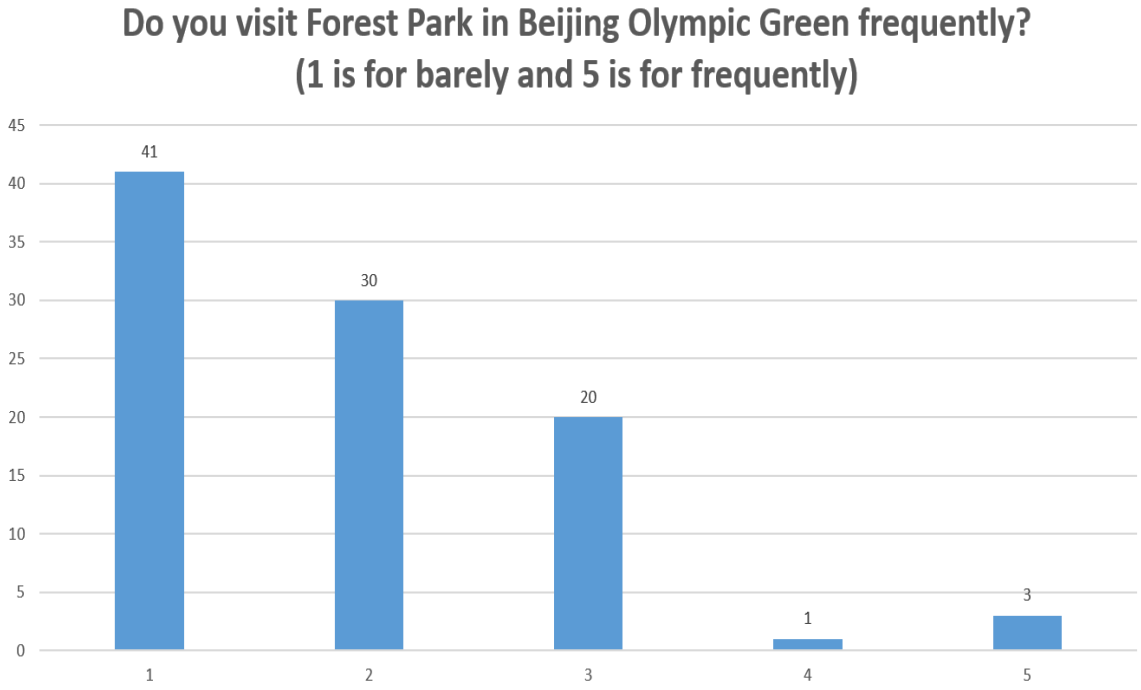
In addition, the most questionnaires were done in the Olympic Green located in Chaoyang district and University Area located in Handian district. Meanwhile, nearly half of the survey participants are visitors and students; the other half are local residents living in Chaoyang district and Handian district. It implied that the local residents, students, and the

visitors traveling to the Olympic Green tended to visit Olympic Forest Park because a considerable portion of survey participants answered they visited Olympic Forest Park most.

It is good to find that a portion of survey participants including local residents, visitors, and local students said that they visited Olympic Forest Park most after the Games. However, as discussed in the above paragraphs, the reason why many survey participants answered they visited Olympic Forest Park most was that nearly the half of the survey participants were visitors traveling to the Olympic Green, most of who tended to visit Forest Park when they were in the Olympic Green since Forest Park was located in the northern part of the Olympic Green and close to the subway station. As a result, the result of the above question cannot indicate that many people visited Olympic Forest Park after 2008 Beijing Olympic Games.

The result of question #25 showed that the majority of survey participants barely visited Olympic Forest Park. In question #25 "Do you visit Forest Park in Beijing Olympic Green frequently? (1 is for barely and 5 is for frequently)", most people, 41 survey participants, said they barely visited Forest Park in Beijing Olympic Green. Only 3 of the participants chose 5 to represent that they visited Forest Park frequently.

Figure 48 Question #25 Do you visit Forest Park in Beijing Olympic Green frequently? (1 is for barely and 5 is for frequently)



The above picture showed that the majority of survey participants barely used the Forest Park, which indicated that the Olympic Forest Park was not sustainable reused in social equitable dimension after the Games. Although Forest Park was planned to be an urban park serving the residents in Beijing, not many local people visited Forest Park and have fun and relax themselves there.

The major reasons for the limited usage of Beijing Olympic Forest Park can be concluded into following several points: the huge area of the Forest Park and the poor inside transportation; not enough activities hosted in the Forest Park; not enough facilities for visitors to relax and have fun.

According to the interview with survey participants, some people said that the forest park was too huge. The transportation situation in the Forest Park was not good. They cannot bear

walking in such hot weather in the summer. Based on my observation in the Forest Park, visitors in this park can only rent a small battery car if they didn't want to walk for long time. However, the small battery car in Forest Park had the following defects. Firstly, the price to rent one car was 50 Chinese dollars[57] for one hour, which was expensive for the normal residents in Beijing. Because the Forest Park was very huge (approximately 1680 acres), visitors usually spent more than one hour to travel in the Forest Park and return the car. Secondly, this battery car was so small. It can only accommodate two persons. If a family visited the Forest Park to have fun, they had to rent two cars, which will cost them more money. Thirdly, visitors can only drive this battery car on the road. They cannot enjoy the forest in the park since there was no road in the forest area. As a result, many visitors complained about it and said they didn't want to rent this small battery car.

[57] About 8 US dollars

Figure 49 The small battery car in the Forest Park

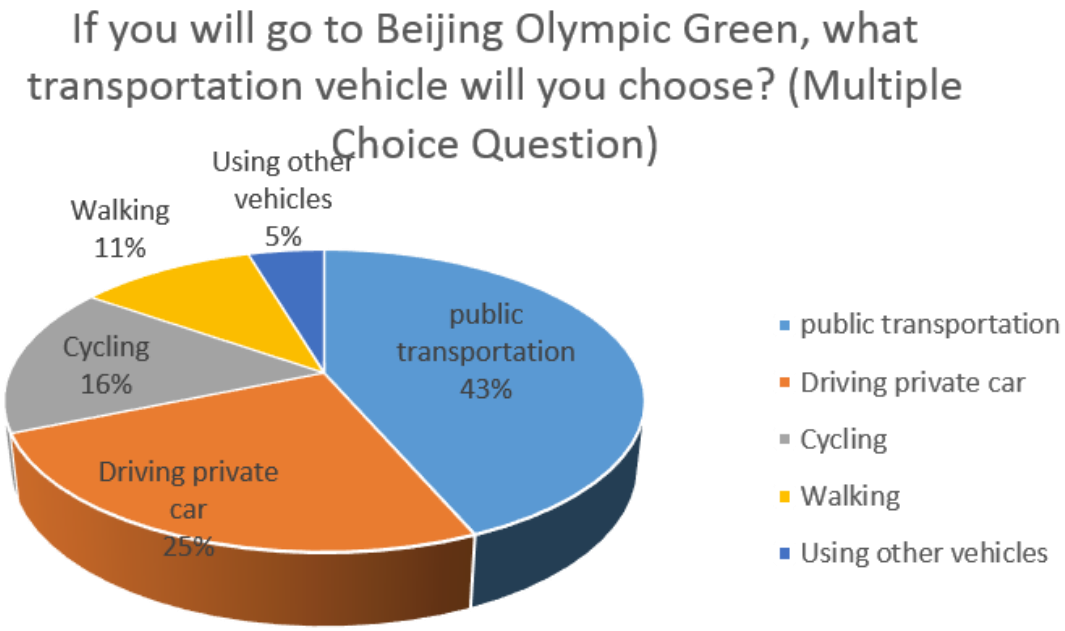
Figure 50 the grassland in the Forest Park

Besides, some survey participants also complained that the Forest Park didn't have many activities. They argued that they were excited when they first visit this urban park. However, they didn't know what they can do when they came there in second time or third time. In addition, some survey participants said that they cannot find any facilities to have a rest in the Forest Park, which made them feel very inconvenient, especially for the elder people.

The majority of the survey participants said they visited Olympic Green by public transportation. Olympic Green consisted of most Olympic stadiums, facilities, Olympic Village, and Olympic Forest Park. Local residents and visitors can use public transportation to there. Thanks to the government subsidies, people can spend only 2 Chinese dollars[58] going wherever they want by subway. The developed and inexpensive public transportation system can help people from different classes visit and enjoy the Olympic facilities such as Forest Park.

[58] About 0.3 US dollars

Figure 51 Question #26 if you will go to Beijing Olympic Green, what transportation vehicle will you choose? (Multiple Choice Question)



5.2.3 Recommendations for Beijing Olympic Forest Park

Based on the results of questionnaire and the observation of the author, I had some recommendations for Beijing Olympic Forest Park, particularly on improve its surrounding environment and promoting social equity through increase the access to the park.

- Strengthening the environmental dimension of Beijing Forest Park

Beijing Olympic Forest Park was planned and positioned to be a “green lung”, a water reservoir, and gene pool of Beijing area after the Games. Strengthening the environmental dimension of Beijing Forest Park can improve its sustainable usage of Olympic Forest Park after the Games.

Olympic Forest Park should be divided into several parts. Some parts can be open to the public for visiting. Some parts should be reserved in order to protect its natural forest, water,

and creatures. Take Beijing Olympic Forest Park as a case, it can be divided into two parts: South Park and North Park. South Park was supposed to be developed as an urban park open to the public. North Park should be protected. Only a few people were allowed to visit North Park every day. The following figure showed the proposed functional divisions of the Forest Park.

Figure 52 the proposed functional divisions of the Forest Park

In the North Park, the natural forest and wetland should be protected. All the facilities and attractions located in this part should be removed so that the natural landscape cannot be influenced. The number of visitors also should be limited in order to provide natural plants and animals living in this part a good natural environment.

South Park can be open to the public. Beijing government can build some facilities and attractions in this part to attract visitors. South Park was supposed to include a large area of grassland for visitors to have fun and relax, a huge lake, and some architectures including a

tower and a temple near the lake to attract more visitors. Besides, some service areas should be located in this part.

- Increasing attractiveness and access to Olympic Forest Park through developing urban forest tourism

In order to improve the social equitable dimension of the Forest Park and attract more residents to visit Forest Park, it was supposed to develop the tourism. Olympic Forest Park, not only in Beijing but also in the rest of the world, had two advantages for the tourism: Olympic background and forest space in the urban area.

All the Olympic Forest Parks around the world including Beijing Olympic Forest Park had the Olympic background which was an advantage to attract more visitors. Olympic background can offer the Forest Park a strong cultural background to attract visitors.

In addition, Olympic Forest Park was a forest park located in the urban area. It had forest, grassland, wetland, and rivers to create a natural environment which was way different from the surrounding urban area. Forest can be an attraction to develop the forest tourism in Olympic Forest Park.

The significance of developing forest tourism in Olympic Forest Park can be summarized as the following points. First of all, forest tourism in Olympic Forest Park can attract more people to enjoy this urban park, which can improve the post-Olympic usage in social equitable dimension. Secondly, in today's world, with the rapid development of urbanization, residents living in the urban area faced a large amount of urban problems such as overcrowding, urban pollution, metal stress caused by the rapid life pace in the city, and so on. Forest tourism in the forest park can help residents go back to the nature and relax themselves,

which can improve local residents' life quality. Thirdly, forest tourism in an urban park can provide local residents an urban space to help them know more about the environment and natural landscape in the forest. It can also make people know more about the plants and creatures living in the forest, which can create a natural class for people, especially the young people.

In order to make use of these two advantages of Beijing Olympic Forest Park, it was supposed to deal with some problems and meet the following recommendations.

Firstly, Olympic Forest Park should be planned as a tourism and cultural park located in the urban area. Many tourism and cultural activities can be hosted in the Forest Park. Since this huge park was located in the populated urban area and the transportation accessibility of this park was good, Beijing Olympic Forest Park can be a great place to host public tourism and cultural activities. For example, in 2009, a beer festival and a photographic exhibition were hosted in National Stadium, which cost the organizers a large number of money for rent. If Beijing Forest Park was willing to host such activities at that time, the activities organizers can save a lot of rent and the Forest Park can attract a lot of visitors in order to make itself sustainable reused in social equitable dimension after the Games. Usually in Olympics' history, the Olympic park tended to be built in a joint place of urban and suburban area due to its huge area. The rental fee to host an activity was not expensive. Olympic forest park can be a great place to host some activities which needed a large amount of land and didn't have the high requirements for the site.

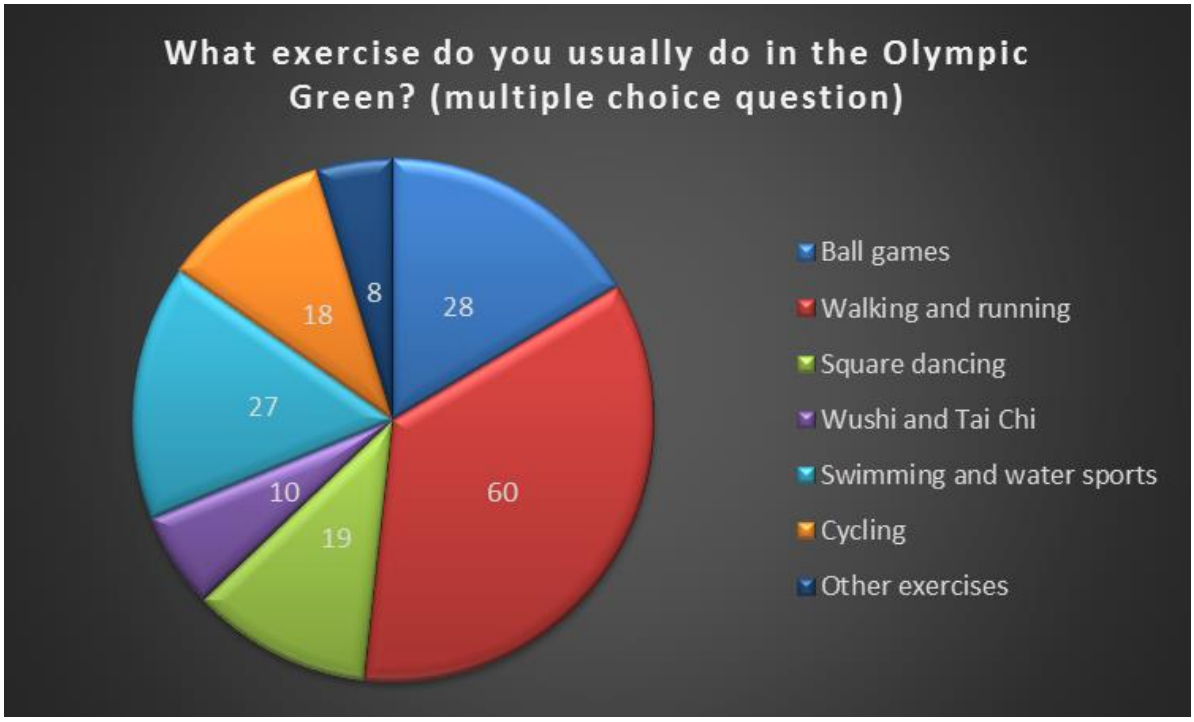
Secondly, the transportation situation in Olympic Forest Park should be improved. The Forest Park was supposed to provide visitors with more vehicles to travel in the park. For

example, the park can let visitors rent bicycles with affordable price since unlike the small battery car, visitors can not only ride bicycles on the road, but also on the grassland and in the forest. As a result, visitors cannot miss the forest landscape in the park because forest and forest eco-system was the predominant attractions in the Forest Park. In addition, the Forest Park can build a small train railway and several stations inside the park, which can make visitors feel more convenient traveling in the park. Moreover, the Forest Park can build more small roads inside for small battery cars and bicycles to improve the transportation situation in the park.

Thirdly, in order to achieve the balance of protecting the natural environment and attracting enough visitors, it is necessary to make Forest Park mix-used after the Games. Forest Park can be divided into several parts. Some areas are supposed to be open without any barriers or fences. People don't need to pay any tickets for entering this open space and be relaxed. Some areas should be reserved in order to protect Beijing biological diversity and gene pool. The local government can also make some money from the tickets.

Last but not the least, Beijing Olympic Forest Park should build more facilities for visitors to have fun and take a rest. According to the results of questionnaire and interviews, many survey participants complained that the Forest Park lack enough facilities inside. In order to meet people's demands and attract more visitors, more facilities were needed.

Figure 53 Question #22 what exercise do you usually do in the Olympic Green? (Multiple choice question)



From the above picture, most survey participants liked to walk and run, play ball games, and do swimming and some water sports in the Forest Park. As a result, Beijing Olympic Forest Park should build more ball games court, enlarge the grassland area, and set up more facilities for swimming and water sports.

Chapter 6 Conclusion

China authority and Beijing government invested a large number of money and resource for 2008 Beijing Olympic Games. They built 22 Olympic stadiums. This thesis described the current usage of each Olympic stadium and the Forest Park after the Games; demonstrated

6.1 Review of findings

Based on the data on post-Olympic usage of venues and the Forest Park, results of surveys and interviews with visitors as well as professionals, and the author's observations during the site visiting, this thesis had the main findings as follows.

First of all, the majority of people answered they didn't care for the post-Olympic usage of Beijing Olympic facilities. Local government needed to do a lot in order to improve the public concerns and public participations on post-Olympic sustainable usage.

Secondly, most Olympic stadiums were not reused well in economic dimension according to the survey participants' opinions and the author's observation. Based on the limited data, Beijing Workers' Stadium was reused well in economic dimension. National Stadium and National Swimming Center were considered to be not as good as the usage of Beijing Workers' Stadium.

Thirdly, according to the SEI (Social Equitable Index), Beijing Workers' Stadium can be considered to be the most sustainable Olympic stadium in social equitable dimension. In addition, University of Science and Technology Beijing Gymnasium, Laoshan Velodrome, Beijing University of Technology Gymnasium, Yingdong Swimming Center, National Stadium (Bird's Nest), and National Swimming Center (Water Cube) can be considered

reused well in social equitable dimension after the Games. On the contrary, Capital Gymnasium, Olympic Tennis Center, and Beijing Shooting Range CTF can be considered not sustainable in social equitable dimension after the Games. Besides, National Indoor Stadium, Wukesong Stadium, and Fengtai Softball Palestrae were not reused well in this dimension because local residents as well as visitors cannot enjoy these three Olympic stadiums since all of which were not open to the public after the Olympics.

Fourthly, The air quality of Beijing were significantly improved during the Olympic Game period due to the government policies, such as relocation of certain industries, restriction of driving and construction, and tree planting. However, most participants were not satisfied with the current air and water quality of Beijing in the post-Game period.

In addition, The Forest Park can reduce the air pollution but cannot solve today's Beijing air problems because the causes of the today's air pollution were diverse, the solution to solve the air problem should also be diverse. Local government had responsibility to adopt other methods such as the relocation of industries and so on to solve today's Beijing air pollution.

Moreover, Beijing Forest Park was not sustainable reused in social equitable dimension after the Games. Most visitors traveled to there by public transportation. The fact that the park is visited by many people first time indicates that it is not mainly served as a neighborhood park frequently used by surrounding residents. It also implies that Beijing Forest Park is very accessible by the general public through public transportation.

6.2 Research recommendations

Based on findings and discussion, the author offered the following recommendations in

this thesis.

First of all, Olympic stadiums should be mix-used. Stadiums can be divided into several places. Each place has its own function. Some places can host sports games or art performance. Some places can be offices. Some places can be rent out to as malls, restaurants, or hotels in order to make money from rent fee and attract visitors.

Secondly, a post-Olympic usage council should be developed to improve public participation. This council can bring together diverse stakeholders to study the current usage of each Olympic stadiums and offer recommendations for some policies change.

Thirdly, local government should improve the transportation accessibility situation and strengthen the linkage with people in the surrounding areas. Local government should build more bus stops near the venues to reduce the time from this Olympic venue to its nearest subway station. Moreover, local government should also enlarge the public parking lots around the Olympic venues in order to make the drivers more convenient to visit Olympic venues. Additionaly, Olympic venues were supposed to decrease the entrance ticket price for people and students living and studying in the surrounding areas.

Fourthly, Olympic Forest Park should be divided into several parts. Some parts can be open to the public for visiting. Some parts should be reserved in order to protect its natural forest, water, and creatures in order to keep balance of protecting the environment and attracting visitors.

Last but not the least, local government should Increase attractiveness and access to Olympic Forest Park through developing urban forest tourism, which can make the Forest Park sustainable reused in social equiatble dimension through providing local residents and

visitors a place to have fun and relax in the urban area.

6.3 Future research

This thesis paper pointed to many possibilities for future research. One question deserving more research was economic index of each Olympic stadium. This research paper didn't adopt economic index to compare which Olympic venue was sustainable reused in economic dimension and which one was not due to the lack of some economic data. If Beijing government published the economic data in the future, it was very significant to create an economic index to represent the current reuse situation of each Olympic venue.

In addition, this thesis showed and analyzed a large number of survey participants' opinions. These survey participants' opinions can only represent what they thought about the current usage of Olympic stadiums and the Forest Park in summer 2014. It was very significant to do another survey to show and analyze local residents as well as visitors' opinions towards the post-Olympic usage of Olympic stadiums and the Forest Park in the future.

APPENDICES

APPENDIX A

THE SURVEY ON THE POST-OLYMPIC SUSTAINABLE REUSE OF BEIJING OLYMPIC FACILITIES

Questionnaire Part I

1. What is your gender?
A Female
B Male

2. What is your age?
A below 18
B 18 to 34
C 35 to 54
D 55 to 74
E 75 or older

3. How many people are there in your family?
A 1
B 2
C 3
D 4
E 5 or more

4. Which of the following best describes your current occupation?
Management Occupations
Computer and Mathematical Occupations
Architecture and Engineering Occupations
Community and Social Service Occupations
Legal Occupations
Education, Training, and Library Occupations
Arts, Design, Entertainment, Sports, and Media Occupations
Healthcare Practitioners and Technical Occupations
Healthcare Support Occupations
Protective Service Occupations
Food Preparation and Serving Related Occupations
Building and Grounds Cleaning and Maintenance Occupations
Personal Care and Service Occupations
Office and Administrative Support Occupations
Farming, Fishing, and Forestry Occupations
Construction and Extraction Occupations
Installation, Maintenance, and Repair Occupations
Transportation and Materials Moving Occupations

5. What is the highest level of education you have completed?
A Elementary graduate
B Middle school graduate
C High school graduate
D Advanced degree

Questionnaire Part II

1. Do you specially care for the post-Olympic sustainable usage of Beijing Olympic facilities?
A Yes
B No

2. As a citizens or visitors in Beijing, do you know is there any stadiums or other facilities unused or abandoned after the Games?
A Yes
B No

3. Which stadium do you think is sustainable used after the Games?

4. Do you think the post-Olympic usage of Beijing Olympic facilities is important?
A Yes
B No
C I don't care

5. If you think the post-Olympic usage of Beijing Olympic Green is very important, the value of sustainable usage after the Games is… (MULTIPLER CHOICE)
A Gain economic benefits after the Games
B Bad post-Olympic usage may lead to the waste of resources and money
C Post-Olympic usage can utilize land resources better
D It can bring benefits and convenience to the local residents and visitors
E I have other reasons

6. What is your opinion towards the current situation about post-Olympic usage of Beijing Olympic Green (1 is for very poor and 5 is for very good)
National Stadium (Bird's Nest) (1 2 3 4 5)
Olympic Tennis Centre (1 2 3 4 5)

Olympic Archery Field	(1 2 3 4 5)
Olympic Hockey Field	(1 2 3 4 5)
Olympic Hockey Field	(1 2 3 4 5)
National Swimming Centre (Water Cube)	(1 2 3 4 5)
National Convention Center	(1 2 3 4 5)
Olympic Village	(1 2 3 4 5)
Olympic Forest Park	(1 2 3 4 5)

7. What department do you think should be responsible for the post-Olympic usage of Beijing Olympic Green? (Multiple choice question)
A Construction developers
B City planning department
C BOC (Beijing Olympic Committee)
D No idea

8. Are you satisfied about current Beijing air quality (1 for very unsatisfied and 5 for very satisfied)

Beijing air quality	(1 2 3 4 5)

9. Do you think Beijing air quality improved or not during the Games, if improved, what do you think the main reason for it is?
A Improved
B Not improved
C I am not clear

10. After 2008 Beijing Olympic Games, do you think Beijing air quality improved or not?
A Improved
B Not improved
C I am not clear

11. Do you think Beijing Olympic Green and its Forest Park can improve Beijing air quality or not?
A It can improve air quality
B It cannot
C No idea

12. Are you satisfied with Beijing current water environment (1 for very unsatisfied and 5 for very satisfied)

Beijing current water environment (1 2 3 4 5)

13. Do you think Beijing Olympic Green and its Forest Park can improve Beijing water environment or not?
A It can improve Beijing water environment
B It cannot
C No idea

14. Do you think Beijing Olympic Green and its Forest Park can reduce Beijing industrial pollution or not?
A It can reduce Beijing industrial pollution
B It cannot
C No idea

15. Do you visit Beijing Olympic Green frequently (1 is for barely and 5 is for frequently)
Frequency (1 2 3 4 5)

16. Which facilities you visit or use most?

17. Are you satisfied about ticket fee for Olympic Green (1 for very unsatisfied and 5 for very satisfied)
Ticket fee for Olympic Green (1 2 3 4 5)

18. Can you afford the ticket fee for Olympic Green?
A Yes I can
B No I cannot

19. What are your main purposes for visiting Olympic Green? (Multiple choice question)
A Tourism
B Exercise
C Entertainment
D Shopping
E Watch sports and art performances
F Attend competitive athlete
G Other purposes

20. Do you visit Forest Park in Beijing Olympic Green frequently? (1 is for barely and 5 is for frequently)
Frequency (1 2 3 4 5)

21. If you will go to Beijing Olympic Green, what transportation vehicle will you choose? (Multiple choice question)
A Public transportation
B Driving private car
C Cycling
D Walking
E Using other vehicles

22. What exercise do you usually do in the Olympic Green? (Multiple choice question)
A Ball games
B Walking and running
C Square dancing
D Wushi and Tai Chi
E Swimming and water sports
F Cycling
G Other exercises

23. Do you think Beijing citizens and visitors from other places use Beijing Olympic Green frequently or not? (1 is for barely and 5 is for frequently)
Frequency (1 2 3 4 5)

24. Do you think is there any problems on current post-Olympic usage of Beijing Olympic Green? (Open-ended question)

25. Do you have any suggestions about the post-Olympic sustainable usage of Beijing Olympic
Green (open-ended question)

APPENDIX B

THE SURVEY ON THE POST-OLYMPIC SUSTAINABLE REUSE OF BEIJING OLYMPIC FACILITIES IN CHINESE

问卷第一部分

1. 你的性别?
A 女
B 男

2. 你的年龄?
A 18 岁以下
B 18 到 34
C 35 到 54
D 55 到 74
E 75 岁以上

3. 你的家里有几口人?
A 1
B 2
C 3
D 4
E 5 个人或更多

4. 以下哪一个可以反映你的职业?
管理
计算机或数学
建筑工程
社区与公共服务
法律
教育
艺术，设计，体育
健康
保护服务
食品和餐饮服务
场地清理
个人护理
办公室和管理
农林渔业
建设
维护修理
交通和物流

5. 你目前的教育背景?
A 小学
B 初中
C 高中
D 高等教育背景

问卷第二部分

1. 您有特别关心过北京奥林匹克公园的后期利用问题么(必填, 单选)

A 有

B 没有

2. 作为一名北京市民，据您所知，对现有北京奥林匹克公园场馆公寓楼以及相关设存在闲置的现象么？（如果存在，请在后面空格列出设施名称）

A 存在

B 不存在

C 不清楚

3. 您认为北京奥林匹克公园中后期利用最好的一个场馆是？

4. 您觉得奥林匹克公园后期利用处理

A 很重要

B 不重要

C 无所谓

5. 如果您认为奥林匹克公园后期利用很重要，您认为其重要性主要体现在

A 后期利用获得经济利益

B 处理不好会造成资源浪费

C 可以更好的利用土地资源

D 后期继续利用可以给周围市民带来方便

E 其它原因

6. 您对目前北京奥林匹克公园场馆主要公寓设施的后期利用的看法是

鸟巢	(1 2 3 4 5)
水立方	(1 2 3 4 5)
游泳中心	(1 2 3 4 5)
国家会议中心	(1 2 3 4 5)
国家室内体育馆	(1 2 3 4 5)
曲棍球场	(1 2 3 4 5)
奥林匹克公园射箭场	(1 2 3 4 5)
国家网球中心	(1 2 3 4 5)
自行车馆	(1 2 3 4 5)
奥运村	(1 2 3 4 5)
森林公园	(1 2 3 4 5)

7. 您认为奥林匹克公园的后期利用应该由哪些部门负责？

A 建筑单位

B 城市规划局

C 活动举办方（北京奥委会）

D 不知道

8. 您对北京市空气质量的满意度如何
满意度 (1 2 3 4 5)

9. 您觉得 2008 北京奥运会期间，北京市空气质量是否上升？如果是，您觉得其原因是什么
A 是
B 不是
C 不清楚

10. 2008 北京奥运会结束，奥林匹克公园投入使用至今，您觉得北京市空气质量是否上升？
A 是
B 不是
C 不清楚

11. 您觉得北京奥林匹克公园以及其森林公园是否有助于提升北京市的空气质量
A 有助于
B 没感觉

12. 您对北京市水资源环境的满意度如何
满意度 (1 2 3 4 5)

13. 您觉得北京奥林匹克公园以及其森林公园是否有助于提升北京市的水资源环境
A 有助于
B 没感觉

14. 您觉得北京奥林匹克公园以及其森林公园是否有助于减轻北京市的工业污染
A 有助于
B 没感觉

15. 您是否经常前去参观北京奥林匹克公园（1=从不去，5=经常去，频率由 1 到 5 递增）
参观频率 (1 2 3 4 5)

16. 您最常参观使用的奥林匹克公园设施是

17. 您对北京奥林匹克公园内部设施门票收费是否满意（1=非常不满意，5=非常满意，满意度由 1 到 5 递增）
满意度 (1 2 3 4 5)

18. 您是否能承受的了奥林匹克公园内部设施的收费
A 可以
B 不可以

19. 您参观北京奥林匹克公园的目的一般是

A 旅游观光
B 锻炼健身
C 游戏娱乐
D 逛街购物
E 观看演出比赛
F 参加竞技运动

20. 您是否经常参观奥林匹克公园森林公园（频率 1 最低，5 最高）
频率 (1 2 3 4 5)

21. 如果您前去北京奥林匹克公园，您一般使用什么交通工具
A 公共交通
B 开车
C 自行车
D 步行
E 其他

22. 您在奥林匹克公园中一般会参与什么样的健身活动
A 球类运动
B 散步，跑步
C 跳舞
D 武术太极
E 游泳，水上运动
F 骑车
G 其他

23. 您觉得北京市民和外来游客对奥林匹克公园的使用程度如何（1 到 5 表示使用程度递增）
使用程度 (1 2 3 4 5)

24. 您觉得目前北京奥林匹克公园的后期利用存在哪些问题

25. 您对北京奥林匹克公园的后期利用有何建议和意见

APPENDIX C

IRB NOT HUMAN SUBJECTS LETTER

Figure 54 No-IRB Letter

MICHIGAN STATE
UNIVERSITY

Determined Not "Human Subjects"

January 16, 2015

PI: Peilei Fan
Email: fanpeile@msu.edu

Re: Determination of Human Subject Research
The post Olympic sustainable usage of Beijing Olympic facilities and forest park (i047611)

Dear Dr.Fan :

It has been determined that the activity described in your application to the IRB submitted 12/05/2014 does not meet the definition of "human subjects" as defined by the U.S. Department of Health and Human Services (DHHS) regulations for the protection of human research subjects.

Human Subject
For DHHS, "human subject" means "a living individual about whom an investigator (whether professional or student) conducting research obtains: (1) Data through intervention or interaction with the individual, or (2) Identifiable private information." [45 CFR 46.102(f)].

After reviewing the information you have provided, it has been determined that:
☐ Living individuals are not involved
☐ The activity is not "about" the living individual
☒ Will not obtain data through interaction or intervention or private identifiable information

Brief explanation: These data were collected as part of a routine classroom assignment in 2014. All data are anonymous and cannot be linked to any individual person. The study team will not intervene or interact with any subjects as part of this request. The investigators want to analyze these data.

Hence, your activity does not involve human subjects.

Therefore, the federal regulations for the protection of human subjects would not apply to your project and you do not need MSU IRB approval to proceed. However, please note that while MSU IRB approval is not required, other federal, state, or local regulations or requirements or ethical or professional standards may still be applicable based on your activity.

If any of these circumstances change, please contact the IRB as your activity may involve human subject research and require IRB approval.

If you have any further questions, please contact the MSU IRB office at 517-355-2180.

Sincerely,

H. McGee

Harry McGee, MPH
Chair, Social Science/Behavioral/Education Institution Review Board (SIRB)
Human Research Protection Program

c: Ziqi Mao

Office of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

Social Science Behavioral/Education Institutional Review Board (SIRB)

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BIBLIOGRAPHY

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Xiaodi Zhu. (2013). The Impact of the Reuse of Beijing's Olympic Green to Beijing's Urban Development. World Architecture. 17-21.

Vojnovic, I. (2014). Urban sustainability: Research, politics, policy and practice. Cities, 41, S30-S44.

Brundtland, G. H. (1987). Report of the World Commission on environment and development:" our common future." United Nations.

United Nations. Scientific Committee on the Effects of Atomic Radiation. (2009). Effects of ionizing radiation: UNSCEAR 2006 Report to the General Assembly, with scientific annexes (Vol. 2). United Nations Publications.

Blaser, A. (2008). The Sustainability Gap: A Case Study of Olympic Development in Sydney, Australia and Beijing, China (Doctoral dissertation, University of Oregon).

Furrer, P. (2002). Sustainable Olympic Games. Bollettino della Societ à Geografica Italiana, (4).

Essig, N. (2010). OPEN HOUSE–Instrument for Assessing the Sustainability Performance of Buildings In Europe. Central Europe towards Sustainable Building (CESB10), Prague.

Sha, M., Xing, G., Zhou, G., Liu, S., & Wang, X. (2009, April). C-mac: Model-driven concurrent medium access control for wireless sensor networks. In INFOCOM 2009, IEEE (pp. 1845-1853). IEEE.

Kitchin, P. (2007). Financing the games (pp. 103-119). Routledge.

Ma, X., Song, L., Yang, Y., & Liu, D. (2013). A gain ‐ of ‐ function mutation in the ROC1 gene alters plant architecture in Arabidopsis. New Phytologist, 197(3), 751-762.

Zhongmo Han. (2013). the Present Situation of Olympic Village, the Concept of Sustainable Development. Science and Technology Information. 218-219.

Shengdong Ye. (2008). the Overall Planning Study on the Sustainable Tourism Development of Forest Park in Beijing Olympic Green. 595-609.

Brux, G. (2006). Stadien der Fu ßball ‐ Weltmeisterschaft 2006: Stahlkonstruktionen mit d ämmschichtbildender Brandschutz ‐ Beschichtung. Stahlbau, 75(12), 1013-1019.

Gregg, T. G., & Smucker, L. A. (1965). Pteridines and gene homologies in the eye color mutants of Drosophila hydei and Drosophila melanogaster. Genetics, 52(5), 1023. LeGates, R. T., & Stout, F. (Eds.). (2011). City reader. Routledge.

Olmsted, F. L. (1870). Public parks and the enlargement of towns. The urban design reader, 28-34.

Howard, E. (1965). Garden cities of to-morrow (Vol. 23). Mit Press.

Jin, L., Zhang, J. J., Ma, X., & Connaughton, D. P. (2011). Residents' perceptions of environmental impacts of the 2008 Beijing Green Olympic Games. European Sport Management Quarterly, 11(3), 275-300.

Wang, H. (2011). Analysis of modern sports marketing of post-Olympic era.

Mol, A. P. (2010). Sustainability as global attractor: the greening of the 2008 Beijing Olympics. Global Networks, 10(4), 510-528.

Digby, B. (2008). The London 2012 Olympics. Geography, 93(1), 40-47.

Joaquin, D. (2012). Olympic Transportation Planning: The Legacies of Barcelona and Beijing (Doctoral dissertation, Columbia University).

Martinson, R. J. (2009). A real options analysis of Olympic Village development: how design flexibility adds value (Doctoral dissertation, Massachusetts Institute of Technology).

Ma, T., & Yang, C. (2009). The Prevention of "Valley Effect" in the Olympic Games of Beijing. Journal of Sustainable Development, 1(2), p116.

Kiuri, M., & Reiter, S. (2013). Olympic stadium design: past achievements and future challenges. ArchNet-IJAR: International Journal of Architectural Research, 7(2), 102-117.

Xu, T., Liu, X., & Chen, L. (2013, October). The Research on Post-Olympics Economic Downturn Effects. In International Academic Workshop on Social Science (IAW-SC-13). Atlantis Press.

Allen, C. (2005). Archaeology and urban planning: Using the past in design for the future.

Fan, P. (2011). Innovation capacity and economic development: China and India. Economic change and restructuring, 44(1-2), 49-73.

Fan, P., & Qi, J. (2010). Assessing the sustainability of major cities in China. Sustainability Science, 5(1), 51-68.

Austrian, Z., & Rosentraub, M. S. (1997). Cleveland's gateway to the future. In R. Noll & A. Zimbalist (Eds.), Sports, jobs and taxes: The economic impacts of sports teams and stadiums (pp. 355–384). Washington, DC: Brookings Institution Press.

Santo, C. (2005). The economic impact of sports stadiums: Recasting the analysis in context. Journal of Urban Affairs, 27(2), 177-192.

Baade, R. A., & Dye, R. F. (1990). The impact of stadium and professional sports on metropolitan area development. Growth and change, 21(2), 1-14.

DONG, L., HU, J., & WU, Y. X. (2006). Ecological Concepts of Plants Planning in Beijing Olympic Forest Park [J]. Chinese Landscape Architecture, 8(6).

Chiesura, A. (2004). The role of urban parks for the sustainable city. Landscape and urban planning, 68(1), 129-138.

Tagtow, R., 1990. The need for urban forests. Am. City County 105, 74–75.