

The Upgrading and Reconstruction Plan of Beijing Planetarium and Related Case Studies

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Keywords: Beijing Planetarium, Construction, Astronomy.

Abstract: As an essential branch of natural science, astronomy is an important branch of natural sciences. It needs supporting high-quality popular science venues to enhance young people's interest in this field and the public's awareness of this field. Moreover, contrasted by several well-known planetarium cases, there is still room for improvement in Beijing Planetarium in China as one of the few large-scale astronomical science places.

1. Introduction

Beijing Planetarium, A hall built in 1955 and the B hall was built in 2001, is China's first planetarium [1]. However, while making significant contributions to the popularization of astronomy in China, the drawbacks and deficiencies of the Beijing Planetarium are gradually appearing, and the facilities in the museum are somewhat improper in maintenance and installation [2]. The exhibition space in the museum is also insufficient due to space constraints [3]. In this paper, with the world's other planetarium contrast, we proposed something that makes Beijing Planetarium upgrade recommendations.

2. The necessity of upgrading and construction of Beijing Planetarium

2.1 The necessity for the construction of planetariums in world-class cities

First-class education breeds first-class cities. Education is a vital support core competitiveness of a city. As a critical part of education, museums are a standard feature in first-class cities. As the capital of China, Beijing undoubtedly meets the standards of first-class cities in all aspects. But in the museum's planetarium which on the one hand, Beijing inferior to the world's other leading cities. Here, the city classification adopts the "World Cities List" published by the Globalization and World Cities Study Group and Network in 2018 [4]. The ten cities in our roster that are rated Alpha+ and Alpha++ are called first-class cities. They are London, New York, Hong Kong, Beijing, Singapore, Shanghai, Sydney, Paris, Dubai, and Tokyo. These ten cities are equipped with at least one planetarium. The names of these planetariums are London's Peter Harrison Planetarium, Hayden Planetarium and Lodz Earth and Space Center in New York, Hong Kong Space Museum in Hong Kong, Singapore Science Museum in Singapore, Shanghai Planetarium in Shanghai (under construction), Sydney Observatory in Sydney, Discovery Palace Science Museum in Paris, Dubai Dubai Planetarium, Tokyo Skytree Planetarium, Planetarium Tokyo, Japan Science Museum, Shibuya Universe Planetarium. The inadequacies of the Beijing Planetarium, compared to the other major planetarium, will be later fingering out.

2.2 The importance of planetarium to astronomy science education

What kind of educational function can the planetarium itself play? A planetarium is a kind of science and technology museum, which can play two major roles in education.

First, provide favorable conditions and platforms for young people. Taking the Beijing Planetarium as an example, the Beijing Planetarium is responsible for the Chinese National Astronomy Team (the national team is responsible for participating in the three major international

astronomy competitions). It also sponsors many astronomy competitions and popular science projects, such as the “Preparing for the Solar Eclipse” Winter Astronomy Science Camp. A public science lecture at the Beijing Planetarium will be held on the third Saturday of every month.

Second, provide effective supplements to school education. Using the Beijing Planetarium as an example, since China’s existing education system (elementary school, junior high school, high school) involves very little astronomy, the nine-year compulsory education involves very little astronomy. The school’s science courses will only explain some common sense of astronomy. In such an educational environment where astronomy education is lacking in mainstream education, the expansion of astronomy knowledge by planetariums becomes very important.

2.3 Inheritance of the ancient capital of astronomy

As an ancient astronomical capital, Beijing should undertake roles to promote the development of astronomy and astronomy popularization. Therefore, an excellent planetarium becomes particularly important to Beijing. The astronomy in Beijing originates from 1279, and astronomers Wang Xun and Guo Shoujing established Sitiantai in today’s north of Jianguomen. After the establishment of the Ming Dynasty, the Observatory of the Stars was established in 1442, which is now the Ancient Observatory of Beijing [5]. The height of the ancient observatory is about 14 meters. The platform’s top is 20.4 meters long from north to south and 23.9 meters from east to west. There are eight astronomical instruments made in the Qing Dynasty. From the early Ming Dynasty to 1929, the ancient observatory has been engaged in astronomical observation for nearly 500 years, and it is the oldest existing ancient observatory with the longest continuous observation record. It also has a long-standing international reputation for its complete construction and complete equipment. This shows that Beijing has a very long astronomical history. Compared with Beijing’s heavy astronomical history, Beijing’s planetarium settings are still far from other astronomical ancient capitals. Ancient astronomy capitals in the world, such as London (Greenwich), all have world-class planetariums.

2.4 The importance of planetarium construction in Beijing’s planning and positioning

In the positioning of Beijing’s new functions, it is the top priority of planning to ease the non-capital functions, coordinate the development of Beijing-Tianjin-Hebei, enrich the historical and cultural heritage, build a scientific and technological innovation center, and cultivate scientific and technological personnel [6]. Among them, the establishment of scientific and technological innovation centers and the training of scientific and technological talents require the support of corresponding popular science bases. The “Standards for the Construction of Science and Technology Museums” formulated by the China Association for Science and Technology pointed out that the Science and Technology Museum is an open science publicity and education institution that does not pursue profit but serves society and social development. It is an important infrastructure for China to implement the strategy of rejuvenating the country through science and education” and an important part of China’s science popularization [7]. The science and technology museum vividly demonstrated to the public the progress of science and technology and its effect on social development with a variety of science and technology exhibits. According to Beijing’s “13th Five-Year” Science Popularization Development Plan, by 2020, 24% of the city’s citizens will have basic scientific qualities [8]. The per capita funding for science popularization will reach 50 yuan. The area of popular science exhibition halls per 10,000 people will reach 260 square meters. The number of popular science personnel per 10,000 people reaches 25. However, based on data at the end of 2017, the Beijing per ten thousand per capita of only 228.18 square meters exhibition area of science; every million people have science staff less than 18 people. It is worth noting that the field distribution of science popularization bases in Beijing is still extremely uneven. The number of basic natural sciences and information sciences, such as physics, chemistry, astrogeography, biology and information technology, is relatively small. The number of cultural bases is the largest, especially “comprehensive” bases account for the highest proportion. Popular science venues in the field of astronomy and geography only account for 4% of all popular science bases. As the leading body of the Beijing-Tianjin-Hebei urban agglomeration, Beijing needs to undertake popular science

education work in surrounding cities. As the deputy Tongzhou city center, the construction of the new district of Xioingan, Beijing Planetarium needs to provide astronomy education for the cities mentioned above. However, the existing conditions of the Beijing Planetarium cannot meet this demand.

2.5 Possibility of special tourism projects in planetarium

Planetariums in major cities in the world have basically become characteristic tourism projects. For example, the Greenwich Observatory has made use of geographical advantages such as 0 degrees longitude and Greenwich Time (the benchmark of world time service) to become very popular projects. The Konica Minolta Planetarium in Tokyo is also famous for its unique astronomical program. In contrast, Beijing Planetarium has not become a special tourism project in Beijing. What is a bit embarrassing is that the Beijing Planetarium often becomes an “attachment” of the Beijing Zoo in travel agencies’ plans because the two parks are separated only by one street, and they often appear Come to the zoo and stop by the planetarium.

3. Current status and problems of Beijing Planetarium

3.1 Status of Beijing Planetarium

The Beijing Planetarium is located at No.138 Xizhimenwai Street, Xicheng District, Beijing. It covers an area of 20,000 square meters and a building area of 26,000 square meters. It was officially opened in 1957. It was the first large-scale planetarium in China and the first large-scale planetarium in Asia at that time. The Beijing Planetarium contains two halls— hall A and hall B and 4 popular science theaters. Hall A is the largest horizontal planetarium in the mainland, and its internal equipment is at the world’s leading level. Among them, the Zeiss 9-type optical planetarium and the world’s highest resolution full-sky digital projection system. It can vividly restore more than 9,000 stars visible to the naked eye on the earth for 400 audiences in the venue and realize virtual astronomical demonstration, three-dimensional space simulation, digital program playback, and other functions through a dome with up to 8K resolution. The B Hall was officially completed and opened at the end of 2004. There are three popular science theaters, including the universe theater, 4D theater, 3D theater, and various science education facilities such as the astronomy exhibition hall, solar observatory, public observatory, and astronomy classrooms. The 4D theater and the 3D theater have 200 and 116 seats, respectively. In addition to broadcasting popular science programs, the Beijing Planetarium also holds various exhibitions, astronomy science lectures, and astronomy summer (winter) camps. Beijing Planetarium integrates display and teaching. By holding astronomy knowledge exhibitions, organizing astronomy Olympiads for middle school students, publishing and distributing popular astronomy books, and many other popular science activities, Beijing Planetarium promotes astronomy knowledge to the public without losing any time and has made outstanding contributions to China’s astronomical popularization.

3.2 Problems in Beijing Planetarium

3.2.1 Stadium facilities

Here, we briefly summarize three problems for the facilities.

1) The aging and damage of exhibits

The aging and damage of exhibits is a very common phenomenon for natural science museums. However, the problems of aging and damage of exhibits in Beijing Planetarium are particularly prominent. The damage to the exhibits in Hall A and the Sun Hall in Hall B is more serious. The establishment time of Fun Star Show is November 10, 2011. The Sun Hall was established on December 12, 2004, and was the first exhibition launched after the completion of the new Beijing Planetarium (Hall B). During the two long-term exhibitions, the venues’ exhibits were not systematically maintained and updated. As of January 30, 2020, among the 10 exhibits in the Sun Hall, 6 are unusable or damaged to a certain extent. The interactive projects of the entire venue are

basically unavailable. This has a very serious and devastating impact on the science popularization of the entire Sun Hall.

2) Small effective exhibition area

The planetarium seems to have a large internal space, but in fact, the effective exhibition area is not enough. Although the planetarium's construction area is 26,000 square meters, the actual exhibition area is only 3122 square meters (1122 square meters in Hall A, 2000 square meters in Hall B), only one-fifth of Shanghai's planetarium exhibit area. The exhibition area of 3122 square meters greatly limits the types and quantity of exhibits. This is also the main problem of the Beijing Planetarium.

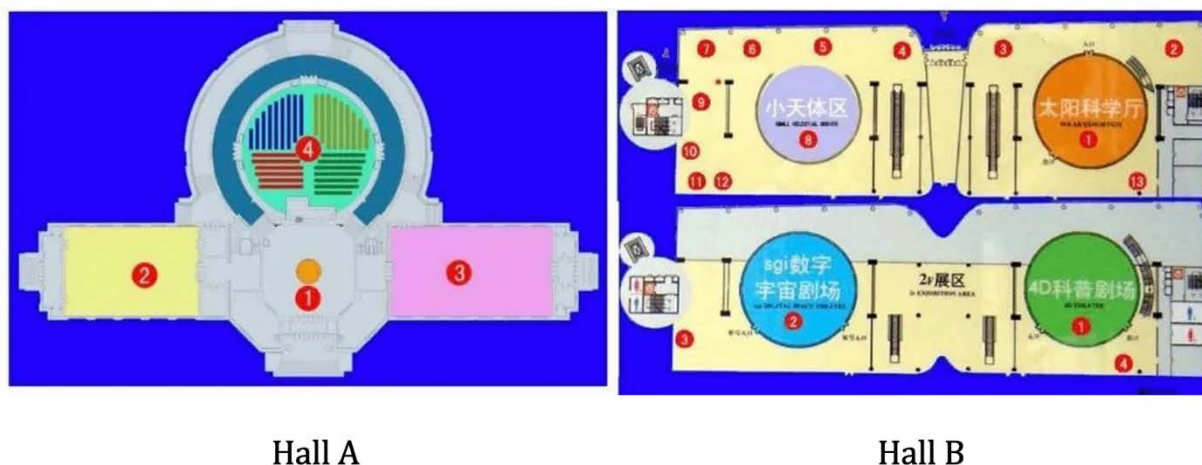


Figure 1. Guide map of Beijing Planetarium

3) The lack of new display technology in the exhibits

Although two sets of motion detection interactive exhibits appeared after the refurbishment of Hall B in 2015, the entire planetarium has nothing to do with new technologies such as VR, resulting in relatively backward knowledge display methods.

3.2.2 Display method

1) Single display method

The display method of the planetarium is still mainly displaying panels, supplemented by interactive exhibits. Due to the fragility of the interactive exhibits and the delay in maintaining the exhibits by the Beijing Planetarium, many interactive devices are in an unusable state. The display panels are not easily damaged, so most of the exhibits available in the Beijing Planetarium are display panels. Although the display board is not easy to damage, because of the long words and obscure knowledge, it is difficult for visitors to the planetarium to have the proper science effect. It is not attractive to young people.

2) The set of interactive exhibits is unreasonable

The Beijing Planetarium has unreasonable settings for many computer-based interactive products. Some interactive products are too difficult, such as the astronomy crazy guessing picture of the challenging island and the game of the moon surface. The experience of some interactive products is not satisfactory, such as the interactive screen in the Sun Family Pavilion, which has serious delays. Some interactive products were damaged and were not repaired, such as the "Space Station Cockpit" exhibit in the Sun Hall and the "Discover New Home" exhibit in Challenge Island. There is even an example of interactive exhibits that contradict the facts-on the basement level of Hall B, the interactive exhibits on the distance scale of the universe. The image of the Straw Hat Galaxy (M104) has an obvious color difference, which is inconsistent with the facts.

3) Strong dependence on professional commentators

Due to the issue of exhibits and the particularity of the subject of astronomy, as well as the general lack of astronomy knowledge among parents and adults, the entire Beijing Planetarium is very dependent on professional commentators. Due to the aforementioned problems of poor

interactive exhibit experience and high damage rate, visitors need the guidance and supplementary explanation of the guide. However, the time and scope of activities for professional commentators and volunteers are limited, and it is difficult to take care of all the time and exhibition area.

4. Types and classifications of planetariums

Due to the characteristics of the planetarium’s history and operation mode, planetariums in the world can be roughly divided into three types: classical planetarium, science-type comprehensive planetarium, and leisure travel-type planetarium.

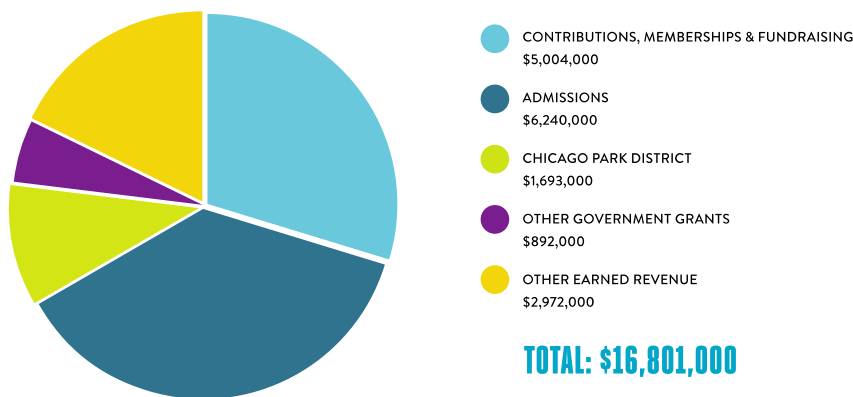
4.1 Classical planetarium-taking advantage of location

Such planetariums generally have a long history and were constructed earlier, and are located in metropolitan cities in the world. In the beginning, they were often located in remote locations in cities, but due to the rapid expansion of the metropolis, such planetariums are often located in the center of metropolitan cities. Moreover, due to the earlier construction of this type of planetarium, the area of the venue is relatively small.

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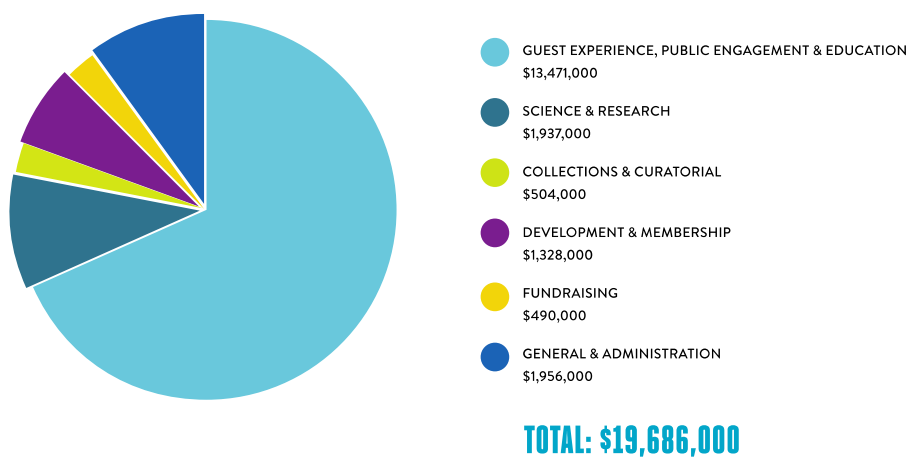


Figure 2. The Adler’s 2018 annual report [9]

4.1.1 Case 1: Adler Planetarium in Chicago

The Adler Planetarium is located on the banks of Lake Illinois in Chicago. It was opened to the public in 1930 and was the first modern planetarium in the western hemisphere. This new public facility has been a great success since its opening. For 85 years, the Adler Planetarium has been leading the development of the American Planetarium and the World Planetarium with advanced concepts, leading technology and rich exhibitions. Since the opening of the Adler Planetarium, it has successfully attracted millions of visitors. The Adler Planetarium has an astronomical hall with a diameter of 21 meters and a span of 190 degrees. A Donner Observatory, built in 1977, has an advanced Cassegrain reflecting telescope. There are also rich exhibitions, including permanent exhibitions and temporary exhibitions. The Adler Planetarium actively uses its geographical advantages in the center of Chicago to carry out activities. For example, in 2019, the museum launched the “Chicago’s night sky” exhibition. The exhibition connects the big city of Chicago with astronomy, which is very important for the occasion. The impact of light pollution on astronomical observations is introduced. This combination undoubtedly enables citizens to understand this originally more abstract astronomical knowledge better. This kind of exhibition combined with urban culture also has the permanent exhibition “Telescopes: though the looking glass” in the museum, which displays Chicago’s famous refracting telescope (a cultural relic). Besides, the Adler Planetarium is still on the 50th anniversary of the moon landing in 2019, collaborated with street artists in Chicago, it launched the “Moonshot Morals” event. The activities of the Adler Planetarium give full play to his advantages in the city center, and the close connection with the city also feeds back to the Adler Planetarium through donations. According to the 2018 financial report of the Adler Planetarium, approximately 30% of the funds were donated [9].

4.1.2 Case 2: Charles Hayden Planetarium, New York, USA

The Charles Hayden Planetarium, part of the Boston Museum of Science, was built in 1958 and is the first large planetarium in New England.

The Charles Hayden Planetarium is 18.3 meters in diameter and has 234 seats. In 1970, it was replaced with a Zeiss 6 planetarium, and in 2003 the Imax giant screen theater was established. In February 2011, after spending 9 million US dollars, after more than a year of renovation and renovation, the grand opening was held. The planetarium is equipped with the most advanced Zeiss starry sky master planetarium and a powerful full-sky digital projection system composed of Digital Sky 2 software and Sony projectors.

4.2 Science popularization comprehensive Planetarium

This type of planetarium is generally located in the center of the city, but the construction time is later than that of the classic planetarium. Due to the late construction time, such planetariums are generally some distance away from the city center. Their floor space, exhibition area, development and expansion potential are larger than those of classical planetariums. Simultaneously, such planetariums are more inclined to science and technology museums, but they are classified as planetariums because of their astronomical instruments.

4.2.1 Case 1: Nagoya Planetarium (located in Nagoya, Japan)

The Nagoya Planetarium is located in Shirakawa Park. It is a comprehensive science museum where you can taste the fun of technology, the universe, and biological sciences while learning. It was completed and opened in 1964. The main hall is called the Science and Technology Hall, which exhibits new achievements in science and technology, ocean and space science, transportation science, chemistry, electronics and atomic energy, and meteorology. The dome of the planetarium is 20 meters in diameter. It is equipped with one of Japan’s largest planetariums and can accommodate 450 spectators.

4.2.2 Case 2: China Science and Technology Museum (located in Beijing, China)

The new China Science and Technology Museum is located at No. 5 Beichen East Road, Chaoyang District. It is adjacent to the Asian Games residential area to the east, the Olympic water system to the west, the Olympic main stadium to the south, and the forest park to the north. It covers

an area of 48,000 square meters and a construction scale of 102,000 square meters. It is an important part of the central area of the Olympic Park that embodies the three concepts of “Green Olympics, High-tech Olympics, and Humanistic Olympics”. The first phase of the China Science and Technology Museum was completed and opened on September 22, 1988, the second phase was completed and opened on April 29, 2000, and the new museum was completed and opened on September 16, 2009. The new hall of the China Science and Technology Museum has five themed exhibition halls, “Science Paradise”, “Light of China”, “Exploration and Discovery”, “Technology and Life”, and “Challenge and the Future”, a public space exhibition area and a dome theater, a giant There are four special effects theaters, including a screen theater, a dynamic theater, and a 4D theater. Among them, the dome theater has both functions of dome screen movie projection and astronomical demonstration.

The China Science and Technology Museum conducts science popularization in various ways and has good results. According to the 2019 annual report of the China Science and Technology Museum (hereinafter referred to as the China Science and Technology Museum). The China Science and Technology Museum conducts science popularization through a variety of methods such as popular science caravans, new media and network platforms, and mobile science and technology museum tours. The goodness rate of exhibits has reached 98.06%. The availability of interactive exhibits will undoubtedly improve the quality and level of popular science in the popular science venues.

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4.3 Leisure and tourism planetarium

Unlike the first two types of planetariums, this type of planetarium is located in a city park or in the natural scenery far from the suburbs of the city. Although it is located in the suburbs, covers a large area, and has great development potential, transportation is inconvenient compared to the first two planetariums due to the distance from the city.

4.3.1 Griffith Observatory (located in Los Angeles, USA)

The Griffith Observatory is one of the world’s famous observatories, located on a hill northwest of the center of Los Angeles, USA. The Griffith Observatory was completed in 1933, opened to the public in 1935, refurbished in 2002, and reopened to the public in 2006. At the Griffith Observatory, you can overlook the white Hollywood on the opposite mountain, or you can overlook the high-rise buildings of Los Angeles.

4.4 Summary

Different types of planetariums have their own unique advantages. In order to achieve the best popular science effect, different types of planetariums need to expand their advantages and maximize their strengths and avoid weaknesses. In order to maximize the effectiveness of the resources in the library.

5. Conclusions and Recommendations

The problems currently exposed by the Beijing Planetarium are the small exhibition area, which is difficult to develop in the future due to the location of the exhibition hall. Some exhibits lack maintenance (exhibits in the Sun Hall are particularly damaged), some exhibits have factual errors, and some interactive exhibits are difficult or challenging to operate.

Most of the problems, such as exhibits, are easy to solve. Because the Beijing Planetarium is classified as a classical planetarium in the above-mentioned classification, it is located in a relatively

central position in the city, and its later expansion is extremely difficult. The only way to achieve better science popularization is to improve the efficiency of the exhibition. Or, it is possible to marginalize the scientific positioning of the Beijing Planetarium's exhibitions and build a planetarium in the suburbs of Beijing. The new planetarium can not only greatly expand the exhibition area, but also can organize what the existing Beijing planetarium can't because of the relatively good light environment in the suburbs.

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