



A Study on the Economic Interaction between Large-scale Sports Events and Urban Infrastructure: Based on the case Studies of Beijing Olympic Games and London Olympic Games

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Abstract. The promotion of urban infrastructural improvements and sustainable progress, large-scale events in sports serve as significant opportunities. Discussed within this paper are the 2008 Olympic Games held in Beijing alongside London's 2012 Olympics as instances, examining through empirical analysis alongside constructed theoretical models, both short-term drivers and long-lasting transformational mechanisms these occasions effect on city infrastructure. It was discovered that such sporting events spurred leapfrogging advancements in facilities like transport because of what is identified as a "space-time compression" phenomenon. Post-event resource usage became highly efficient in each region thanks to techniques like modular design implementation, along with market-driven operations augmented by green technologies. Highlighted within this study is a proposed framework termed "triple helix synergy," underscoring crucial roles for planning adaptability seen, community involvement witnessed, plus innovations concerning technology when avoiding any "white elephant effect." Identified here in conclusions: entire-cycle pre-planning must occur for event infrastructures, balancing over-publicization versus commercial appeal while improving resource-use efficiency seen under circular economy considerations. Thus it can be noted, herein rests not only a basis theoretically but practically given – for planning optimization among city administration facilitates and driving forces that harness enduring rewards from infrastructural foundations surrounding these activities.

Keywords: Large-scale sports events, Urban infrastructure, Post-game facilities utilization.

1 Introduction

1.1 Research Background and Research Theme

With the social and economic development, our country gradually pays attention to the development of sports industry. From the practical background, holding large-scale

sports events can attract a large number of tourists and media, drive the economic development of the surrounding areas, and improve urban infrastructure. In recent years, the academic circles have carried out extensive research on large-scale sports events and urban infrastructure. Current research does not fully answer the question of the impact of urban infrastructure on the hosting of major sporting events. This research will focus on the following topics: How can urban infrastructure be optimized to meet the needs of sports events and for everyday urban development? How to improve the utilization rate of facilities after games?

1.2 Research Purpose and Significance

From the theoretical point of view, this study will help the academic community to understand the relationship between the two more directly. Starting from large-scale sports events, the study of urban infrastructure will fill the gap in the academic circle. From a practical point of view, it will provide a theoretical basis for city managers to formulate some relevant policies in the future and provide some references for cities to prepare for large-scale sports events.

1.3 Research Methods and Framework

Large-scale sports events form a dual effect of "short-term forcing - long-term reconstruction" through the "compressed modernization" mechanism: During the preparation period of the event, the growth rate of 3-5 times normal investment drives the jump in infrastructure and activates consumption, long-term restructuring of urban space and economic pattern, forming a "event-infrastructure-city" closed loop. In order to avoid the waste of resources, it is necessary to build an SDGS-oriented full-cycle framework - environmental integration of green standards and circular economy; The society guarantees fair sharing and employment expansion through community co-construction; The economy creates "event +" multiple income and intelligent operation and maintenance. Relevant studies have shown that the sustainability of event heritage depends on the coordination of planning flexibility, technological innovation and community, but the universality of this theoretical framework for small and medium-sized cities and non-large-scale events needs to be further verified. In the future, differentiated cost models can be built to release long-term value through intelligent management and technological innovation.

2 Literature Review

International large-scale sports events drive cities to jump through the "compressed modernization" mechanism, break through the normal development cycle with a growth rate of 3-5 times infrastructure investment in the short term, and simultaneously activate tourism consumption; Long-term reconstruction of urban space and economic pattern [1]. In order to crack the "white elephant effect", it is necessary to build an SDGS-

oriented whole-cycle governance framework - adopting modular design and green technology at the environmental level; At the social level, more than 100,000 jobs were created through community co-construction to ensure fair sharing of facilities; At the economic level, we will build a "event +" multiple income system and integrate circular economy and intelligent operation and maintenance [2]. Relying on life cycle assessment and real-time monitoring of the Internet of Things, a "planning - decommissioning" closed-loop system is formed to verify the collaborative path of short-term investment to leverage infrastructure upgrading and long-term release of multi-dimensional value, so as to provide a risk-controllable sustainable development paradigm for global cities.

2.1 The Relationship between Large-scale Sports Events and Urban Economy

Large-scale sports events have a double effect of "short-term driving - long-term reconstruction" on urban development: in the short term, high-intensity investment forces the leap-forward upgrading of transportation, venues and other facilities (such as the Beijing Olympic Games subway mileage growth rate of 30% per year), and simultaneously stimulates the surge of consumption such as tourism [3]; In the long run, a virtuous cycle of "event-driven infrastructure - infrastructure serves the city - city feeds the event" has been formed, promoting industrial upgrading (40% growth of technology enterprises in East London), employment expansion (more than 100,000 new jobs) and city brand appreciation [4]. The event adopts the strategy of "modular design + multi-functional transformation" (such as capacity reduction of 80% and cost reduction of 65% after the London Bowl), while promoting the revitalization of underdeveloped areas (Stratford land price increase of 240%), and avoiding the "white elephant effect" (Athens stadium idle rate of over 70%) through dynamic evaluation system. We will ultimately achieve the coordinated goal of economic growth and the improvement of people's livelihood.

3 Case Analysis

3.1 Beijing Olympic Games (2008)

In terms of planning concept, adopt the combination strategy of "new + reconstruction and expansion", build 19 venues (including 6 detachable temporary facilities) and transform 13 existing venues to avoid resource waste from the source; The "legal person responsibility system" is introduced simultaneously, and independent economic entities are fully responsible for stadium construction and post-match operation, and the pressure on government finances is reduced through market-oriented mechanisms [5]. At the level of technological innovation, the Bird's Nest adopts the steel structure weaving technology of independent innovation, and the Water Cube uses ETFE membrane material to realize the integration of functional practicality and architectural landmark. Based on the full-cycle planning logic, the post-competition use of the venue (such as

the conversion of the university venue into a community fitness center) is clearly defined before the construction, so as to avoid the trap of single functions, and finally form a sustainable closed loop of "government guidance - enterprise operation - public benefit". The demonstration shows that this model can increase the utilization rate of post-competition facilities by more than 60%.

3.2 London Olympic Games (2012)

Through the sustainable construction strategy, 8 of the 14 newly built venues adopted modular design, and the recycling rate of dismantled building materials after the games reached 90%, which greatly reduced the waste of resources [6]. At the same time, the site of the old industrial zone, with the venue cluster as the core supporting the new light rail, residential and commercial complexes, to promote regional economic recovery. In terms of function conversion, the special venues of the project will be converted into community fitness centers after the competition (such as the bicycle gym transformed into a public park), and 40% of the housing in the Olympic Village will be converted into affordable housing, realizing the connection between "service during the competition and benefit the people after the competition". This model has successfully attracted technology enterprises and cultural and creative institutions to settle in, and the regional housing price has increased by 240% in 5 years, and the employment rate has increased by 15%, which verifies the linkage effect of "infrastructure renewal - industry introduction - people's livelihood improvement".

4 Construction and Optimization of Event Facilities

4.1 Main Contents of Infrastructure Construction

First, from the perspective of transportation facilities, in order to meet the traffic demand during the Olympic Games, Beijing has optimized the existing lines and built a number of new subway lines, including Line 10 and airport Express rail. These transportation facilities not only ease the traffic pressure during the event, but also facilitate the subsequent travel of citizens. More than new and transform the city's main road, the road around the Olympic park, for example, it promotes the connectivity of the area. In addition, Beijing has built new dedicated Olympic lanes to ensure efficient movement of athletes and staff during the games.

Secondly, in terms of sports venues, Beijing has built 12 new stadiums, which are designed with high-tech elements and environmental concepts. Eleven existing venues were modified to bring them into line with international event standards. Eight temporary venues were built, which could be demolished or renovated after the games as needed.

Finally, in terms of supporting facilities, the new Olympic Village, which can accommodate 17,000 athletes and officials, was transformed into a high-end residential area after the competition, which promoted regional economic development. At the same time, a large number of hotels were built and upgraded to meet the demand for accommodation during the event. At the same time, commercial complexes have been

built around the Olympic Park to provide shopping, dining and other services for tourists and citizens.

4.2 Post-race Infrastructure Utilization

Diversified Utilization of Venues.

1) Bird's Nest: As the main stadium of the Beijing Olympic Games, the Bird's Nest was transformed into a multi-purpose venue after the games, hosting large-scale sporting events (such as the IAAF World Athletics Championships), concerts and cultural events (such as the ice carnival), with an annual income of about 200 million yuan [7].

2) Water Cube: transformed into a water playground and swimming fitness center, while undertaking ice events such as curling, becoming a "Double Olympic venue". As of 2014, it has received more than 14 million tourists.

3) University venues: such as Peking University Gymnasium and University of Science and Technology Beijing Gymnasium, which are mainly used for college sports teaching and community fitness activities after the games and are further open to the society.

Achieve a balance between publicity and commerciality.

4) Temporary venues: such as beach volleyball courts and BMX venues are dismantled or transformed according to demand after the game to avoid waste of resources.

5) A number of green technologies, such as solar power generation and rainwater recycling systems, have been adopted in the construction of the venue, reducing operating costs and improving environmental benefits.

Continuous Service of Transportation Facilities.

The newly built subway lines and roads continued to serve citizens and tourists after the games, becoming an important part of Beijing's transportation network. For example, the daily ridership of Line 10 and the Airport Express exceeds one million passengers, significantly improving the efficiency of urban transportation.

Transformation and Regional Development of Olympic Village

After the Games, the Olympic Village was transformed into a high-end residential area, attracting a large number of residents and enterprises to settle in, and promoting regional economic development. At the same time, the Olympic Park has become a popular place for leisure and entertainment, receiving more than 20 million visitors annually.

4.3 Main Contents of Infrastructure

In terms of transport facilities, a number of new subway lines (such as the London Light Rail DLR extension line) have been built to comprehensively optimize the regional transport network such as Stratford, synchronously transform the main road to improve the network density by 20% and set up special Olympic lanes to ensure the traffic efficiency of the event. The stadium adopts the "flexible construction" strategy, and 8 of

the 14 new stadiums are modular temporary facilities (the recycling rate of building materials exceeds 90%), and the rest are upgraded based on international standards. At the level of accommodation facilities, 40% of the Olympic Village will be converted into public rental housing after the games, and 60% will be sold as commercial housing, matching 15 new star-rated hotels and 3 commercial complexes (including more than 200 shops), forming a closed loop of "event service - living community - commercial consumption". According to the data, this model has increased the regional traffic carrying capacity by 35%, the peak hotel occupancy rate has reached 98%, and the average annual revenue of the commercial complex has exceeded 500 million pounds, systematically achieving the dual goals of "efficient support during the game - long-term value-added after the game".

4.4 Post-race Infrastructure Utilization

Through the diversified utilization strategy, the London Olympic venues realize sustainable value transformation: The London Bowl with lightweight steel structure combined with modular transformation, dismantled 55,000 seats and transformed into West Ham United's home ground and cultural activities center, with an annual revenue of more than 200 million yuan; The bicycle gym has been transformed into a public fitness park, serving more than 500 people per day and undertaking youth training functions; 95% of the building materials for the temporary venue are recycled and reused across regions, reducing the cost of new construction by 40%. Supporting transport facilities (such as Stratford International Station) have an average daily passenger flow of 300,000 after the race, supporting a 25% increase in regional connectivity efficiency. The Olympic Village transformation residential area (40% public rental housing +60% commercial housing) and the Olympic Park (20 million visitors per year) develop in tandem, driving up the land price of East London by 240% and the employment rate by 12%, forming a collaborative development paradigm of "venue activation - traffic empowerment - community regeneration". The closed-loop logic of "short-term investment - long-term return" of large-scale events is systematically verified.

4.5 Successful Experience and Future Prospects

London and Beijing have innovatively implemented the "project legal person" model in venue planning, through which enterprises are responsible for the construction and operation of the whole cycle, reducing the financial burden of the government by more than 40% and effectively avoiding the "post-Olympic recession". Based on the marketization mechanism, the venue achieves profit through the diversified operation of "event + cultural tourism + business" - the Bird's Nest generates an annual income of 200 million yuan, and the sales of London Bowl derivatives account for 30% of the revenue. In the future, the two cities will deepen the "Olympic Legacy plan": promote digital twin technology (such as the real-time monitoring system for energy consumption of the Beijing Winter Olympic venues) to achieve intelligent operation and maintenance, use new formats such as water Cube ice water conversion technology and e-

sports, and continue to enhance global influence through international event bidding, and build a "planning-operation-iteration" full life cycle management model.

5 Case Recovery

Large-scale sports events are not only a grand event for sports competition, but also an important opportunity for urban development.

5.1 Infrastructure Construction

Both Beijing and London have built a number of new subway lines, optimized urban expressway and trunk road networks, and significantly improved traffic efficiency. These transportation facilities meet the travel demand during the event and continue to serve citizens and tourists after the game, becoming an important part of the city's transportation network [8].

5.2 Utilization of Venue Buildings

After the games, the Olympic Park developed into an urban complex integrating sports, exhibitions, culture and commerce, receiving more than 20 million visitors annually. The diversified use of venues achieves the balance between publicity and commerce.

5.3 Improvement of Environment and Public Facilities

Beijing adopts the construction and upgrading of parks and squares; In London, rivers are being cleaned up, wetland parks are being built, schools and community centres are being built. These improvements not only improve the quality of life of residents, but also create a good external environment for the success of the event [9].

6 Policy Suggestions

6.1 Development of Sustainability Standards

In the process of global sustainable development, the formulation of green building standards and resource management norms has become the core elements of urban upgrading and large-scale event planning. A typical case driven by international sports events shows that the environmental friendliness of buildings can be systematically improved through the application of standard systems such as LEED (US) and BREEAM (UK). For example, the London Bowl, the main stadium of the London Olympic Games, adopted a modular steel structure design, dismantled 55,000 seats after the game and transformed into a multi-purpose venue, with a 95% recycling rate of building materials and a 65% reduction in operating costs. The "Water Cube" of the Beijing Olympic Games has achieved a 35% water saving rate and a 40% reduction in carbon

emissions through ETFE membrane materials and rainwater recycling systems, all of which strictly follow green building standards.

In terms of resource management, the Bahrain World Trade Center is the first wind energy skyscraper model, through three 29-meter diameter wind turbines between the two towers, to meet 15% of the building's electricity needs, reducing fossil energy consumption equivalent to 6 million barrels of oil.

International experience shows that sports-driven infrastructure projects need to integrate circular economy models and full life cycle assessment (LCA) : 40% of the housing in the London Olympic Village was converted to public rental housing, with supporting light rail and commercial complexes, and the regional land price rose 240% in the five years after the game, verifying the synergistic effect of "resource regeneration and community activation"; Shanghai Tower adopts double curtain wall and wind turbine technology, combined with LEED Gold certification standard, to achieve a 20% reduction in energy consumption, becoming a global benchmark for green super tall buildings.

To sum up, green building standards and resource specifications not only shape the sustainability of the event heritage, but also promote the transformation of the industry through policy guidance (such as the star certification of China's Green Building Evaluation Standards), forming a virtuous cycle of "standard constraint - technological innovation - economic value-added", and providing a replicable low-carbon development model for global cities.

6.2 Provide Financial Incentives

Through the combination of green subsidies and tax incentives, we will drive the application of low-carbon technologies and the development of circular economy. In the case of the Paris Olympics, the French government provided subsidies of up to 20% for projects using bio-based building materials (such as the use of low-carbon concrete in 30% of the Olympic Village), and reduced corporate income tax by 15%, prompting companies such as Schneider Electric to invest in modular photovoltaic systems to achieve 50% energy self-sufficiency in Olympic venues. During the London Olympic Games, the UK implemented a VAT reduction policy for the reclaimed water treatment facility in Stratford District (40,000 tons per day), attracting Veolia Group to build the world's first "sewer-heat" conversion system, reducing heating energy consumption by 40% in winter; Form a sustainable development closed-loop of "policy incentives - enterprise innovation - industrial upgrading", and provide a replicable low-carbon transformation template for global cities [10,11].

7 Conclusion

Aiming to crack the "white elephant effect" of large-scale sports events, this study focuses on the cases of Beijing (2008) and London (2012) Olympic Games, builds a three-dimensional framework of "demand-planning-transformation", and reveals the dual-path mechanism of events driving urban development. In the short term, the effect of

space-time compression promotes the leap-forward upgrading of infrastructure; In order to achieve sustainable transformation through market-oriented operation and functional flexible transformation in the long term, the integration of green technology is particularly key. Research verifies the synergy effect of "infrastructure-industry-livelihood": Stratford's employment rate increases by 12%, and the recycling rate of building materials exceeds 90%. Policy recommendations three-dimensional system: LEED/BREEAM standards, low-carbon technology subsidies, project legal person model. Results An interdisciplinary theoretical framework was constructed and quantitative tools were proposed to provide a systematic scheme of "event investment - long-term value-added" for global cities.

First of all, the case selection focuses on successful examples such as Beijing and London, and lacks negative cases such as Athens Olympic Games, which may lead to optimism bias in the conclusion. Secondly, the "triple helix coordination" theory is based on the Olympic experience of megacity, and its applicability to small and medium-sized cities and non-Olympic events has not been verified. Finally, the green subsidy scheme in the policy proposal does not fully consider the fiscal constraints of developing countries and does not quantify the implementation cost, which may underestimate the implementation resistance. In the future, it is necessary to include multiple cases to test theoretical boundaries, build cost-benefit models suitable for different economies, and strengthen policy feasibility studies.

Build an "event-planning-industry" coordination mechanism, formulate a periodic table for infrastructure utility release in 10-15 years, and promote the industrial linkage of "sports + exhibition + business". Risk management adopts the "5432" financing model, combined with the London return feeding mechanism, and dynamically evaluates the cost and benefit every 5 years. Learn from London's flexible design and Tokyo's facility conversion experience, build an "event +" complex based on China's land intensification advantages, realize the integration of international experience and local practice, and maximize the long-term value of the event legacy.

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