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After the Crowds: Redemption Frameworks for Overbuilt Olympic Sports Venues

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Abstract: Many studies have documented the common problem of venue underutilization after mega events such as the Olympic Games and the FIFA World Cup, which imposes a heavy financial burden on the host cities. This paper aims to provide practical and empirical suggestions for improving venue underutilization through research and analysis of dismantled and existing sports facilities. Under the sharing and circular economy frameworks, we comparatively analyze the venue sustainability of different mega sports venues through site selection, construction, and after-event operation phases. In the site selection phase, we suggest choosing a location near the city, cooperating with universities, and building on existing infrastructure. In the construction phase, we recommend refurbishing or reusing existing sports stadiums to optimize space utilization rates, enhancing the versatility of venues, and using reusable materials and renewable energy sources. Suggestions for after-event operations include sharing sports stadiums for multiple purposes and improving resource reallocation. Our paper improves the venue utilization of mega sporting events from circular and sharing perspectives.

Keywords: overbuilt, sports venues underutilization, big-sport event, venue sustainability, circular economy, sharing economy

1. Introduction

Qatar hosted the FIFA World Cup in 2022, demonstrating its commitment to sustainability through sustainable strategies in stadium construction [1]. To bid for this big tournament, Qatar submitted a comprehensive development plan based on the era of sustainability to be considered for these events. Using those extensive sports construction is an essential component of the post-event legacy. Stadiums must meet both development needs and resource conservation requirements. In recent years, sharing and circular economic modalities have gained significant attention due to social concerns resulting from the underutilization of world-famous event stadia built for mega-events like the Olympic Games and FIFA.

The superlative that will rule people's memories regarding those significant sports events is not athletic but financial. The mega-event is usually to blame for funding problems, pre- and post-. In

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many past essential sports events, however, most Olympic venues couldn't be repurposed after the games since the post-game development, and the use of media was not considered from the outset, resulting in a heavy financial burden for the host cities [2]. To guarantee any cost overruns of the mage event in Brazil in 2007, the Brazilian federal government was compelled to provide a blank check. This opens the door, both figuratively and practically, for issues with greed and corruption that led to a financial overrun of 10 times the estimated cost for the 2007 Pan American Games [3]. The total costs of the 2014 Sochi Olympics were nearly $55 billion, a figure higher than the frequently reported $51 billion [4]. For the Summer Games in 2008, the local government in Beijing invested roughly $40 billion in significant urban renovations [5].

However, these successful Games seemed not fully utilize the stadia and infrastructure, as seen by the "uncertain legacy" of Sydney two years after the 2000 Games, Athens's challenges in finding appropriate uses for its venues, Beijing 2008 Games' mainly vacant bird's nest stadium, and the countless hoarded or boarded-up facilities in Rio, Sochi, and elsewhere [6]. Oversized infrastructure at exorbitant costs, paid for nearly entirely by the public, is the principal legacy of the Sochi Olympic Games 2014, after which the level of underutilization and the cost of the infrastructure are unmatched [4]. Although Legacy Transformation work had progressed for the Sydney Olympic Games, the stadium's future strategy shift before 2012 had a detrimental influence on it. It caused a further "calamitous cost overrun" throughout the transition phase, which exemplifies many problems with policy for neoliberal planning, including the construction of pricey landmark structures, top-down political decision-making, and taking risks at the expense of the general people [6]. This paper will assess the problem and conduct a case study analysis based on three stages of the life cycle of large event venues, including site selection, construction, and after-event operations.

Major sporting events are generally attractive opportunities for regional governments to upgrade and rebrand their cities [7]. This is because sports mega-events are integral to the global culture industry, providing an opportunity to market a place, advertise tourism, and establish a commercial zone[8]. Most of the monumental buildings built for these sporting events become local landmarks. Those buildings have coincidentally become the world's top issues and challenges post-game. There is thus a need for effective planning for good practices, increasing access to the public, and changing the image of stadiums so they can be used for other purposes after an event is over. The recent FIFA World Cup 2022 hosted by Qatar emphasized the post-event usage of the sports venues. The solution for providing stability to sports stadia after the event is to adopt a multi-stakeholder approach, where the facility can be used for economic, environmental, and societal purposes [9]. Another example of a sustainable after-event operation is the National Stadium in Taiwan, the first stadium powered by solar energy. It produces 100% of the energy it needs on event day and feeds or shares the energy it generates with the nearby community. Using circular economy and sharing strategies, the National Stadium in Taiwan was designed and built as highly sustainable [10].

By reviewing the construction history of the Olympics and FIFA, an important goal of competing for the host of these mega-events is to push regional development. Most likely, the choice of site location was made to enhance economic circumstances and local welfare, which requires high utilization efficiency after the events. Bale emphasized the symbolic significance of football stadiums in Britain as physical symbols [11] due to the stadium's location in an urban setting with many social gathering spots and convenient access by foot, bike, or public transportation. Tynecastle Park is an example of the power and emotions that may be associated with a place, perhaps even more so than with the excellence of the stadium itself [12]. Jiuzhou Sports Arena in China also benefited from urbanization. The facility moved geographically closer to the city years after it was finished and became more easily accessible to city residents and has progressively grown in popularity as a location for sports and leisure activities which a nearby school also uses to host music festivals, sports matches, and other cultural activities [13].

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However, the venue's location can also be blamed for the lack of force for economic growth and underutilization. In Sochi Olympic Games 2014, due to the North Caucasus' dangerous environment and the de facto state of Abkhazia being only outside Georgia's internationally recognized border, security concerns overtook economic ones. They were crucial to guaranteeing the safe conduct of the Games, not to mention the high-security costs incurred (over six times than planned) [4]. Sydney's Paramatta was also located in spatially peripheral sites to boost the area. Nevertheless, venue reuses have been addressed as an issue because of the absence of demand for football matches [14]. Due to a lack of visitors, the ice-sport complex in PyeongChang and Gangnung have also turned into white elephants, and the maintenance costs were high and had to be paid by the local government [15]. From the beginning of drawing pictures for mega-events, planning and designing for the event venues starts with the site location. All the construction ideas and budget planning will be based on that. Whether facilities will be constructed from scratch or upon the existing infrastructure will decide the volume and distribution of budgets. Distances between the sites and the urban core affect communities' willingness and frequency to visit the venues, directly impacting profitability and utilization after events.

Building construction is the second important factor in determining post-game utilization of venues. Refurbishing existing sports stadiums instead of building new media can help reduce construction costs and limit white elephant problems. For the 1984 Olympic Games, Los Angeles decided to construct only four new venues and reuse seventeen existing platforms, which restricted spending on venue construction, contributing to a budget surplus that helped further fund new or refurbished sports facilities in Southern California [6]. Building designs with reusable materials or renewable energy has become increasingly popular to enhance sustainability. Qatar's Ras Abu Aboud stadium was built with reusable containers that can be disassembled after the FIFA World Cup in 2022. The circular design allows the containers to be reused for various applications, such as retail units and temporary storage in local urban farming [1]. Research has shown that many Canadian sports venues are shifting to renewable energy. One notable example is the Air Canada Centre which uses a Deep Lake Water Cooling System for its air conditioning [16]. This sustainable system pioneered using renewable energy in stadiums, significantly reducing energy consumption and the cost of maintenance and operation. Efficient design also improves space utilization and expands the potential for non-game activities. By adopting thousands of retractable seats in the stadium at the Dalian University of Technology in China, the available space was increased to 65% of the total area, providing sufficient conditions for a variety of entertainment and fitness activities following games [17].

Nevertheless, there are still many stadiums built with excess capacity that end up being unsustainable and raise the problems of white elephants. Sochi 2014 and Rio 2016 were accused of being the most unsustainable games due to construction cost overruns, while most of their venues were not used after-game [18] meaningfully. World Cups in Korea/Japan, and South Africa also had construction problems of overcapacity, which can be examined by the low stadium utilization index developed by Preuss [19]. Construction has a non-negligible impact on venue utilization as the amount of new construction, the design for further reuse, and the selection of construction materials directly determine construction costs that affect government budgets and reusability that affect utilization. Reusability has been an issue for many sports stadiums that rarely offer ideal conditions for other activities, presenting challenges for construction design.

Intuitively, architectural distinctiveness can be used to attract more tourists to the region. As a result of this increase in human traffic, the local economy has been revitalized[20]. However, Searle has argued that huge stadiums' newly built construction sustainability is often questioned due to the high operating and maintenance costs [21]. This issue is more prominent in the Winter Olympics [22]. The ice hockey centers and skating arenas for PyeongChang were constructed and renovated with

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$100 million [23], but they proved to be white elephants because residents rarely use them. After all, those sports require specific skills [24]. As a result, the underutilization of those sports venues indicates that the government faces a financial problem. In addition, due to financial difficulties, no company was interested in operating these facilities, and those destructions incurred additional expenses of more than US $1m each year for the Korean government [15]. Another example of an unsustainable operation is the Alpensia resort, a luxurious sports and tourism complex built for winter sports events. Despite the period of global mega-events, the hotel remained vacant most of the time and suffered an US$11m deficit in 2018 [25]. The Olympic budget allocates a very high proportion of its construction costs. However, in PyeongChang's case and previous significant sporting events, constructions appeared to be designed solely for the Olympics without systematically considering post-game operations. Even though each state is required to provide a sustainable plan during the bidding process, the implementation of sustainability fails to meet the required standards. It creates a new social problem in the host city.

By integrating the cases above in the three stages of a venue's life cycle, this paper first analyzes the problem of venue underutilization and the relevant impacts of negative and positive externalities through sharing and circular economy models. It then discusses the potential optimal strategies to address the problem based on geographical and event features, aiming to serve as a model for further construction and post-event operation of large venues.

2. Methodology

This paper conducts further analysis under a sharing economy and circular economy framework. Discussions have recently increased about replacing a linear consumption model with a cyclical one that requires resources from the environment and then becomes a resource itself [26]. As discussed in World Economic Forum, the circular economy and the sharing economy interact well together [27]. The sharing economy is complementary to the circular economy. It is based on resource-driven innovation at the individual, company, and government levels which represents a node shift from the Industrial Revolution to the development of the Internet [28]. Most definitions of the sharing economy focus on sharing already-existing, underused assets among owners without a change in ownership [29]. The term "circular economy" describes an industrial economy that, by design or intention, is regenerative and focuses on sustainable materials and cradle-to-cradle principles. The circular and sharing economies both emphasize the effective and sustainable use of resources by people, businesses, and governments.

3. Analysis & Discussion

3.1. Site Selection

The decision to choose the site location was taken to improve the local economy and welfare, which calls for high usage efficiency of the venues built after the events. However, the problem is that some cases aggravate the government's and the public's financial burden. The underutilization of those fabulous venues also conflicts with the idea of sharing and a circular economy.

Taking the Sochi Olympic Games 2014 as an example, to modernize the larger Sochi region, the mega-event cost $55 billion, which was approximately 4.5 times as much as what was first projected ($55.0 billion vs. $12.3 billion). Officials from the state and the event's organizers have insisted that not all costs should be included in the total. They asserted that the actual price of the event was $7.1 billion, which just covered the venues for sporting events [30]. All additional expenses were seen to be beneficial for the area's growth over the long run. One of the cost categories that needed to be noticed was six times what was planned for security costs. Instead of choosing the location near the major hubs, Sochi is located in the North Caucasus region, which provides a geopolitically unstable

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environment, directly over the internationally acknowledged border with Georgia from the de facto state of Abkhazia. Authorities also sensed a growing threat from terrorist attacks throughout the Games' planning phase. Their suspicions were later verified by several assaults, including one just a few weeks before the Olympic Games.

Underutilization of those costly venues was a severe problem. The location didn't provide a safe or peaceful environment for sharing the economic and social value of the facilities after events. The direct consequence of the deliberate environment was the lack of tourists and events. Residents may avoid professional or recreational sporting events because they fear terrorist strikes. For the planned after-use of the facilities, most of the venues in the mountain cluster were about to serve as training grounds for future Olympians [4]. After using some small platforms to provide shared value, the speed skating oval became the site of a tennis academy, and the small hockey stadium became a sports center for children. But the after-use of the Olympic Park was piecemeal. Few tourists visit the Park due to the absence of attractions and its far distance from the city center and the main beaches.

Another issue of the Sochi Olympic Games is that all facilities needed for the mega-event were constructed from scratch. This is highly not acknowledged with the concept of sharing existing infrastructure. It directly gave rise to the financial burden and waste of public resources. Even though Sochi voiced the lovely aspiration of accelerating regional growth in one colossal push and propelling Sochi into a world-class attraction, the failure of the economy and society was caused by the lack of consideration for sharing and circular value during the planning phase.

To improve the utilization of those large-scale underused assets, the case of Sochi provides some inspiration for applying sharing and circular ideas for constructing large-scale sports venues. Even though the most widely accepted definition of the sharing economy refers to an existing asset, the article suggests planning for concerns rather than attempting to address them as they arise. The first step of planning is to choose a location near the urban cores, where the distance won't be a problem for visiting. This can be the foundation of generating sharing value of large venues. No matter how significant or many events are invited to the forum, citizens' willingness to pay a visit would decide the facility's profitability. One more specific suggestion for planning the location is to settle near universities. One representative example is the Jiuzhou Sports Arena in Mianyang, China, built for the 2005 World Amateur Boxing Championships. It went vacant afterward due to the lack of sporting events. Even though some regions of the complex, such as the swimming pool, table tennis hall, and tennis courts, were available to the public, there were hardly any visitors due to the complex's distant site, which made transportation into the city's center problematic [13]. However, China's rapid urbanization and economic development have affected the Jiuzhou Sports Arena's fate. The facility moved geographically closer to the city years after it was finished. It is now close to multiple housing developments and a new university campus. The institution cooperated with the university to hold basketball games, and music festivals, shared value with collaborators, and improved the utilization of the close site location to cities.

Applying the sharing economy concept is not limited to plans about short distances for shared value creation. It may also involve utilizing current infrastructure to its benefit. Unlike Sochi 2014, the sites of more decentralized Games, like Atlanta 1996, have been shown to gain from the demand that already exists in the metropolitan areas around and from not having to wait for planned infrastructure or development to be completed [6]. This example also indicates the circular value created by decentralized urban planning and public resources.

3.2. Construction

The design and construction process plays a vital role in determining the after-event utilization of venues. In contrast, the scale of media and their relations with the local environment and society may generate problems regarding sustainability. Sochi 2014, blamed as the least sustainable Olympic

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game, was a particular case that violated the circular economy model and generated many negative externalities. Constructing Olympic venues and resorts in environmentally sensitive areas and building illegal roads had severe negative impacts on the local ecosystem, resulting in habitat damage, biodiversity loss, deforestation, water depletion, and pollution while increasing the risk of potential geological hazards such as erosion, landslides, and mudslides [31]. The destruction of protected areas for local species and ecosystems can be seen as the opportunity cost of construction, which runs counter to the circular economy model that aims to reduce environmental externality costs.

Moreover, the construction of the Olympic infrastructure failed to transfer from the conventional linear consumption model to a restorative circular model in a lack of good reuse and recycling. Though the Russian official claimed the Olympic city Sochi was "a city without landfills," the report by EWNC has indicated that it was unsuccessful in achieving the circular goal of "reduce, reuse and recycle" proposed by the International Olympics Committee [31], with evidence showing that tons of construction waste were transported to an illegal landfill. The unlawful dump fouled the air and local water supply, while the debris sliding into a stream that runs into the Black Sea led to further water pollution and fish loss, significantly reducing residents' quality of life [32].

The demolition of numerous homes had even more severe social impacts on residents. According to Human Rights Watch [33], the eviction of 2,000 families from their homes to make room for Olympic venues had been a severe issue. Most of these homes received insufficient or no compensation at all. People who reallocated also faced the security problem and issues with the heating and structure of new houses. Since most of them made a living from farming or renting out their seaside dwellings, this impacted their living conditions and put their jobs and income in threat. There were even more violations of human rights regarding the laborers who constructed the venues. Many migrant workers were abused by poor wages, excessive working hours, inadequate meals and accommodations, and illegal passport withholding [34].

In addition to the externalities of environmental degradation and social injustice, the economy was not benefited from the construction due to the enormous cost overrun of 337% [4]. Despite the high construction cost, many buildings were underused, resulting in heavy strain on the state budget with $1.2 billion of maintenance and operation fees per year. As reported by Bøhmer, the combined railroad and highway that cost $9 billion-plus externalities was used only once a day [31]. The excess capacity and poor utilization of venues highlight the issue of white elephants and present a challenge for future planning and refurbishing of the construction.

Based on the construction problems and the externalities to the environment, society, and economy analyzed above, the following potential optimal strategies are discussed to address the issue under the circular economy model. First, discover the potential of refurbishing or reusing existing sports stadiums rather than building new ones. This helps reduce construction costs and lessen the financial strain on the government, as indicated by the budget surplus of the Los Angeles 1984 Olympic Games, which constructed only four new venues while reusing seventeen existing ones [6].

Second, construct with reusable materials and renewable energy to reduce material waste and energy consumption. The circular design of Qatar's Ras Abu Aboud stadium combines a steel structure with repurposed shipping containers so the stadium can be disassembled entirely after the FIFA World Cup in 2022 [1]. Renewable energy can also be applied based on local climate or geographical features. For instance, Qatar's dry subtropical desert climate with low rainfall ensures sufficient sunlight. Hence, the air conditioning systems in 7 stadiums in Qatar are powered by solar energy collected from a nearby solar farm, contributing to carbon saving and demonstrating Qatar's commitment to environmental sustainability [35]. Another example is the Air Canada Centre which is located near Lake Ontario. Its air conditioning system adopts a Deep Lake Water Cooling System, significantly reducing energy consumption and costs [16].

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Third, design to increase space utility rate and enhance venues' versatility, including auxiliary rooms. If new platforms are necessary to build, then the construction design should be appropriately carried out to match the goals of post-event operations. Installing removable or retractable seats in the stadium can help increase the available space, providing sufficient conditions for possible fitness and entertainment activities after games. With the awareness of the excess demand for seating capacity over Qatar's local needs, RAA built easily disassembled seats and planned to donate approximately 170,000 to countries in need after the games [1]. Additionally, the extra rooms in the venues for athletes, news media, and VIP spectators also have a post-game high vacancy rate [17]. Construction design should consider the similarity in spatial layout to increase the flexibility of reusing these rooms. For example, the washrooms for different groups can be built centrally in one stadium area to save on piping materials, which can be easily merged into a potential public bath open to residents to generate post-event revenue.

3.3. After-event Operations

Stadiums are generally operated to host large and mega sporting events [9]. However, there are many instances where hosts fail to plan for venue operations following the event. This section aims to provide post-event operations strategies using the circular and share economy models to deliver socioeconomic benefits. After the game, a sustainable post-game operation is a great chance to promote sustainability and preserve a valuable outcome. In this section, we identify two post-event operation strategies consisting of (1) resource reallocation in terms of circular economics and (2) better building utilization based on sharing an event, evidenced by Qatar's FIFA 2022 WC and the Winter Olympics in Pyeongchang 2018.

Qatar's RAA stadium served as a venue for several during the 2022 World Cup. The stadium can accommodate 40,000 spectators [36]. Nine hundred seventy-two shipping containers were used in the construction, along with steel structural components and removable seats [36]. Overlays can be disassembled for a different purposes to reduce energy consumption from a sustainability perspective. Research has shown that the circular design, when operated temporarily for one year, can reduce human health impacts by 60% and reduce reliance on imported building materials compared to the conventional approach when working permanently for 50 years [1]. It is possible to reuse shipping containers in a variety of ways. According to the circular economic perspective, containers can naturally be applied in urban agriculture as retail or temporary storage units. Secondly, using refurbished containers as permanent residential housing facilities is an excellent option. For example, the PV14 modular house in Dalla, built with shipping containers, is a great example [37]. Furthermore, the containers can be shipped internationally to serve as refugee shelters, providing temporary shelter for disaster victims. A few countries, including Indonesia, Japan, and India, have operated similarly in the past [1].

The question of how to share sports stadiums with more citizens and improve the usage of these stadiums has become a worldwide issue recently. It is uncommon for sports stadiums to be turned into commercial facilities that attract investment. These facilities can be used as schools, shops, theme parks, or sports theme museums. This is the case with Qatar's Lusail Stadium or Education City Stadium.

The Lusail Stadium is one of the largest stadiums in Asia, with a seating capacity of 80,000, which hosted the finals of the FIFA WC [38]. In addition to housing the event, the stadium will be shared with schools, shops, cafes, sports services, and a healthcare facility. Moreover, Education City Stadium is also an excellent example of sharing stadium resources to serve as a sporting, recreational, and social center in the community and be utilized as a means for sports development by non-governmental organizations [9].

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A sustainable plan to share the venue in a diversified way is typically proposed as part of the bidding process for these mega sporting events. However, it is imperative to keep an eye on the sustainability and sharing plan's implementation, even though it has been promised. The Winter Olympics in Pyeongchang 2018 is a typical example of failure to meet sustainability promises. After the competition, the temporary stadium built for the Winter Olympic Games was dismantled and became a construction waste. The legacy management institution, the PyeongChang 2018 Legacy Foundation, failed to fulfill its sustainability-sharing promise, causing a substantial financial cost to Gangwon province [39]. The construction companies responsible for building the sports facilities and social infrastructure in Gangwon were the true winners in this competition [21].

Therefore, sharing stadium usage and circular economy applications can support the post-event legacy and enhance the sustainability benefits of mega sporting events. However, sustainability thinking must be considered at the earlier stages of site selection and building construction to utilize the resources of large-scale projects circularly. This is what we mentioned in the previous section. Further, governments usually offer many innovative ideas during the post-event operation by converting and sharing the construction to maximize the utilization of the building. However, the sustainability promise may not be fulfilled due to the financial crisis or practical operation and various social issues occurred. Hence, it is prudent to examine other post-game activities before concluding, based on our experience from the PyeongChang Winter Olympics, to ensure Qatar's FIFA 2022 World Cup is a sustainable event.

3.4. Summary

Table 1: Good practices and guidebook for planning.

<table>
<tr><th>Phase</th><th>Site Selection</th><th>Construction</th><th>After-event Operation</th></tr>
<tr><td>Sharing Economy</td><td>Close to the city & Cooperate with universities (e.g., Jiuzhou Sports Arena)</td><td>Design to increase space utility rate and enhance the versatility of venues (e.g., Qatar RAA)</td><td>Share sports stadiums for purposes other than sports, such as schools, shops, theme parks, or sports theme museums (e.g., Lusail Stadium or Education City Stadium in Qatar)</td></tr>
<tr><td rowspan="2">Circular Economy</td><td rowspan="2">Construct upon existing infrastructure (e.g., Atlanta 1996)</td><td>Refurbish or reuse existing sports stadiums (e.g., Los Angeles 1984)</td><td rowspan="2">Improve resource reallocation in terms of circular economics (e.g., Qatar RAA)</td></tr>
<tr><td>Construct with reusable materials and renewable energy (e.g., Qatar RAA)</td></tr>
</table>

This study investigates the issue of venue underutilization and the pertinent consequences of negative and positive externalities using sharing and circular economy models by combining the scenarios above in the three stages of a venue's life cycle. The lack of sharing economy base and the neglect of existing infrastructure are issues to be addressed during the site selection process. The paper's construction phase covers the harmful externalities of the economy, social injustice, and

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environmental deterioration. Another issue is the lack of preparation for venue operation after the event. The probable best approaches to solve the issue are then discussed based on the regional and event characteristics to serve as a template for future significant venue development and post-event operation. Good practices and guidebooks for planning for large venues are summarized under the sharing and circular economy framework in Table 1.

4. Conclusion

Venue underutilization has been a widespread issue following significant sports events such as the Olympics and FIFA World Cup, causing the problems of white elephants and cost overruns while generating negative externalities, including environmental degradation, social injustice, and fiscal deficit. By applying sharing and circular economy approaches, we discuss the potential strategies to increase the utilization of venues across the three stages of their lifecycle. For site selection, closer distance to the city and cooperation with universities can help ease the future operation of sustainable plans. For construction, refurbishing, or reusing existing venues, designs to increase space utilization and venue versatility and adopt reusable materials and renewable energy can reduce construction waste and cost. For post-event operation, it is crucial to enable multi-purpose sharing of sports facilities and reallocate resources to maximize venue utilization. Our summary of best practices can serve as a model for planning and operating sports venues and provide optimal criteria for future research to examine the sustainability of platforms.

Though this paper proposes strategies to address the underutilization problem, our study still has limitations. First, many data in the case studies analyzed in this paper are obtained from secondary sources, which poses potential risks to their accuracy and reliability. Second, we endorse the sustainable venues for the 2022 FIFA World Cup based on their existing design and future operational plans while the game has just ended, and more time is needed to test their plans' actual effectiveness and long-term sustainability. Furthermore, our suggestions address the standard issue, but different measures need to be adapted to local conditions. Therefore, further research is required to examine whether Qatar venues successfully meet the objectives of post-game sustainable operation. We recommend that future studies focus on region-specific cases and collect more data from local primary sources.

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