

Creative Placemaking in Green Stadiums Leveraging Circular Economy

A Strategic Framework for Sustainable Sports Entrepreneurship

HIWA BAHRAMFARD¹, SOMAYEH NAJARGHABEL^{2*}, JAMAL ROSHANZADEH³

¹DEPARTMENT OF STRATEGIC MANAGEMENT, FACULTY OF MANAGEMENT AND ACCOUNTING, FARABI CAMPUS,
UNIVERSITY OF TEHRAN, TEHRAN, IRAN

ORCID: 0000-0003-3276-4155

²PH.D. OF URBAN ECONOMICS, ECONOMIC DEVELOPMENT AND PLANNING DEPARTMENT, FACULTY OF ECONOMICS
AND MANAGEMENT, UNIVERSITY OF TABRIZ, TABRIZ, IRAN

ORCID: 0009-0001-2163-661X

³PH.D. CANDIDATE OF URBAN ECONOMICS, ECONOMIC DEVELOPMENT AND PLANNING DEPARTMENT, FACULTY OF
ECONOMICS AND MANAGEMENT, UNIVERSITY OF TABRIZ, TABRIZ, IRAN

ORCID: 0009-0008-3232-7389

EMAIL: HIWA_BAHRAMFARD@UT.AC.IR , SOMAYEH.NAJARI@TABRIZU.AC.IR , JAMAL_ROSHANZADEH@YAHOO.COM

CORRESPONDING AUTHOR: SOMAYEH NAJARGHABEL

Abstract

Objective: Stadiums are increasingly expected to reduce environmental burdens while generating durable social and economic value beyond match days. This article develops and examines a strategic framework linking green-smart infrastructure, circular-economy processes, social-creative placemaking, and entrepreneurial outcomes. It treats the stadium not simply as an event facility but as a potential anchor for an inclusive, low-waste, mixed-use urban ecosystem.

Methodology: The proposed design is exploratory sequential mixed methods. A qualitative phase uses semi-structured interviews and thematic analysis to develop constructs and indicators, followed by a survey-based structural model. The material supplied for this draft includes a proposed coding structure and a diagram of standardized path coefficients; however, the quantitative tables were explicitly described in the source material as illustrative outputs for reporting practice rather than verified empirical results. Accordingly, the numerical SEM results are presented below as provisional model outputs requiring confirmation against the original dataset and software files, not as independently verified findings.

Findings: The supplied model proposes positive relationships from green-smart infrastructure to circular-economy processes and social-creative placemaking, from circular-economy processes to placemaking and entrepreneurial outcomes, and from placemaking to entrepreneurial outcomes. The diagram reports standardized coefficients ranging from .17 to .61 and an R^2 of .69 for entrepreneurial outcomes. These values suggest a plausible explanatory structure, but inferential claims, mediation estimates, and model-fit conclusions cannot be treated as confirmed until the raw data, measurement model, estimator, and bootstrap output are audited.

Contribution: The framework connects environmental operations with place-based social value creation and sport entrepreneurship. It also specifies practical mechanisms—renewable energy, water reuse, resource recovery, local cultural programming, community participation, and small-business access—through which stadium assets may support year-round economic activity. The article offers a transparent, submission-oriented structure while distinguishing theoretical propositions from results that still require empirical verification.

Keywords: creative placemaking; green stadiums; circular economy; sustainable sports entrepreneurship; sport tourism; structural equation modeling.

1. Introduction

1.1. Background and problem statement

Stadiums are unusually concentrated urban assets. They combine large built environments, energy- and water-intensive operations, event-related mobility, food and merchandise supply chains, and periodic surges in visitor demand. Their environmental footprint is therefore shaped not only by operational energy use but also by construction materials, transport, procurement, waste, and the wider supply chain. Research on the FIFA World Cup Qatar 2022 illustrates why a life-cycle perspective matters: indirect supply-chain emissions and construction-related impacts can be substantial, meaning that operational efficiency alone does not capture the full sustainability challenge (Al Sholi et al., 2023). Recent work on environmentally sustainable stadiums likewise identifies energy, waste, materials, carbon reduction, community engagement, flexible design, and circularity as connected priorities rather than isolated interventions (Lyu, 2024).

At the same time, many stadiums remain underused outside scheduled events. A venue that is active only on match days may incur high fixed costs while missing opportunities to provide local services, cultural programming, recreation, tourism experiences, and commercial space. This gap is not simply a facilities-management problem. It is a strategic question about how stadium operators can combine environmental performance with community value and entrepreneurial activity. A stadium can become more than a destination for spectators if its physical assets, public realm, identity, and partnerships are deliberately organized around repeated everyday use.

Creative placemaking offers a useful lens for this transition. It refers to place-based processes through which culture, creativity, local identity, and community participation shape public spaces and strengthen social connection. Recent conceptual research highlights the contribution of creative placemaking to place identity and social cohesion, while work on new development areas emphasizes the importance of designing for a meaningful sense of place rather than relying on physical construction alone (Dash & Thilagam, 2023; Sobhaninia et al., 2023). For stadiums, this implies that a concourse, plaza, surrounding street, or underused room can be programmed for local arts, markets, youth activities, community sport, and small enterprises, subject to accessibility, safety, and operational constraints.

Circular-economy thinking adds a resource strategy to this place-based approach. Instead of following a linear take-make-dispose pattern, stadium operators can reduce resource inputs, extend the useful life of assets, reuse materials, recover value from waste streams, and procure products and services that enable reuse or recycling. Circularity is not synonymous with recycling alone: it includes design, procurement, maintenance, sharing, repair, reuse, and the management of rebound effects that can offset environmental gains (Silvério et al., 2023; Lowe et al., 2024). Digital monitoring and smart infrastructure can make these practices more visible and manageable, but technology creates value only when it is integrated into organizational routines, procurement, and stakeholder cooperation (Toth-Peter et al., 2023).

The central problem addressed here is the limited integration of these strands into a coherent stadium-management framework. Green infrastructure is often considered through technical performance, circularity through waste or procurement, placemaking through public-space design, and entrepreneurship through business development. Treating them separately can obscure the mechanisms by which environmental assets create social and commercial opportunities. A stadium may install solar panels and efficient lighting without creating a stronger community destination; it may host markets without managing their waste and supply chains; or it may promote tourism without ensuring that local micro- and small enterprises can participate. The strategic challenge is to align these activities so that environmental investments enable circular operations, circular operations support attractive and responsible place experiences, and those experiences create opportunities for sustainable sports entrepreneurship.

1.2. Research purpose and questions

This study proposes an integrated framework linking Green-Smart Infrastructure (GSI), Circular Economy Processes (CEP), Social-Creative Placemaking (SCP), and Entrepreneurial Outcomes (EO). It asks: (1) How is green-smart infrastructure associated with circular-economy processes and social-creative placemaking? (2) Do circular-economy processes contribute to placemaking and entrepreneurial outcomes? (3) Is social-creative placemaking associated with entrepreneurial outcomes? and (4) Does the proposed model offer a credible basis for explaining

entrepreneurial outcomes once its measurement and structural properties are verified?

1.3. Contribution and article structure

The article contributes in three ways. First, it connects stadium environmental management with the social production of place and the entrepreneurial use of sport assets. Second, it frames circular-economy processes as an organizational mechanism linking infrastructure investments to broader value creation rather than as an end-of-pipe waste intervention. Third, it translates the framework into testable paths and managerial actions. The remainder of the article reviews the theoretical foundations, specifies hypotheses and methods, reports the supplied model outputs with appropriate caveats, discusses implications, and identifies the verification steps required before journal submission.

2. Theoretical framework and literature review

2.1 Green-smart infrastructure as an enabling capability

Green-smart infrastructure comprises the physical and digital systems that reduce environmental impacts while improving the ability to monitor and manage venue operations. Examples include renewable-energy systems, efficient lighting, smart metering, water reuse, rainwater collection, and data-enabled monitoring of consumption. These investments may reduce operating costs and improve resilience, but their strategic significance extends beyond efficiency: they create the technical conditions for better resource planning, environmental reporting, and coordination with suppliers and users. Stadium sustainability research identifies owner support, budgets, partnerships, expertise, and stakeholder pressures as important influences on the adoption of environmental features (Lyu, 2024).

A resource-based interpretation suggests that infrastructure becomes strategically valuable when it is combined with organizational routines and partnerships that competitors cannot easily replicate. Yet physical assets alone do not guarantee sustainable outcomes. Infrastructure must be linked to procurement standards, maintenance schedules, staff capability, community expectations, and measurable performance indicators. Accordingly, the framework treats GSI as an enabling capability expected to support circular processes and place-based activity.

2.2. Circular-economy processes in stadium operations

Circular-economy processes include waste prevention, separation and recovery, reuse of materials, circular procurement, food-waste valorization, water recirculation, repair, and the extension of product and asset life. The systematic review by Silvério et al. (2023) shows that circular-economy research increasingly examines strategic implementation and the organizational and technological conditions that support it. Toth-Peter et al. (2023) similarly emphasize that digital technologies can enable circular business models but that transition requires changes across multiple business-model elements. Stadiums are a particularly relevant setting because their demand is episodic, procurement is complex, and large visitor flows produce concentrated material and food-waste streams.

Circularity can also support commercial experimentation. Reusable cup systems, repair and resale initiatives, food redistribution, recycled-material merchandise, refill stations, and shared equipment services may reduce resource use while creating new supplier relationships or customer propositions. However, circular practices should be evaluated through actual material flows and life-cycle consequences, not only the presence of recycling bins. Rebound effects are a further caution: efficiency savings can be partly offset if total activity or consumption expands (Lowe et al., 2024). The model therefore positions CEP as both an environmental operating system and a possible bridge between infrastructure and new forms of value creation.

2.3. Social-creative placemaking and stadiums as everyday destinations

Creative placemaking combines cultural activity, community participation, local identity, and spatial programming to make places meaningful and regularly used. Dash and Thilagam (2023) propose a conceptual model connecting creative placemaking with social cohesion in community spaces, while Sobhaninia et al. (2023) examine the need to foster a sense of place in new development areas. Applied to stadiums, the implication is that social value depends not simply on the architecture of a venue but on what happens there, who feels welcome, and whether activity is sustained beyond major events.

Potential applications include local artist residencies, community markets, public art, inclusive recreational programs, local-food events, school partnerships, and small-business

kiosks. These activities may strengthen place attachment and create reasons to visit outside event hours. They can also improve the legitimacy of sustainability initiatives when residents have meaningful roles in shaping them. Placemaking should nevertheless avoid becoming a purely promotional exercise: affordable access, local representation, universal design, safety, and the distribution of commercial benefits are central to whether a stadium ecosystem is genuinely inclusive.

2.4. Sustainable sports entrepreneurship and opportunity exploitation

Sports entrepreneurship involves identifying and exploiting opportunities within the sport ecosystem through innovation, creativity, resource mobilization, and calculated risk-taking. Hammerschmidt et al. (2024) synthesize the relationship between entrepreneurship, innovation, and creativity in sport management and argue for a more integrated view of the field. Sustainable entrepreneurship adds environmental and social value to the opportunity process, rather than evaluating success solely through short-term financial returns. Sarma et al. (2024) discuss factors shaping sustainable opportunity recognition and exploitation, including the interaction between entrepreneurs and their operating context.

A stadium may provide entrepreneurs with access to audiences, facilities, brand associations, event calendars, supplier networks, and a visible platform for testing new services. Opportunities may include circular merchandise, low-impact catering, sports-tourism packages, accessible recreation, event technology, local cultural experiences, and reuse or repair services. The Iranian sport-business studies supplied by the authors also foreground bricolage and entrepreneurial decision-making in sports SMEs (Bahramfard et al., 2025). These works are relevant to the argument that entrepreneurial outcomes may depend not only on resource abundance but also on how entrepreneurs recombine available resources, interpret opportunities, and make decisions under constraints. Their full bibliographic details should be checked against the original journal records before final submission.

2.5. Integrating the constructs

The proposed framework combines the four constructs in a sequential but not strictly linear system. GSI is expected to support CEP by enabling measurement, efficiency, water management, and material handling. GSI may also directly support SCP by making spaces more comfortable, adaptable, accessible, and suitable for mixed uses. CEP may enhance SCP when visible resource stewardship becomes part of the visitor experience and when circular activities—such as repair workshops, reuse markets, or local food systems—become part of venue programming. CEP may also create entrepreneurial opportunities through new products, services, and supplier models. Finally, SCP may contribute to EO by attracting recurring visitors, strengthening local partnerships, and creating settings in which businesses can test offerings.

This logic is consistent with a stakeholder-oriented view: value is co-produced by stadium owners, public authorities, local residents, cultural organizations, visitors, suppliers, and entrepreneurs. It also cautions against assuming that any single technical intervention automatically produces business growth. The framework proposes associations to be tested; it does not establish causality without suitable design, measurement, and identification.

3. Hypotheses and conceptual model

Hypothesis	Proposed relationship
H1	Green-smart infrastructure is positively associated with circular-economy processes.
H2	Green-smart infrastructure is positively associated with social-creative placemaking.
H3	Circular-economy processes are positively associated with social-creative placemaking.
H4	Circular-economy processes are positively associated with entrepreneurial outcomes.
H5	Social-creative placemaking is positively associated with entrepreneurial outcomes.
H6	Green-smart infrastructure has a positive direct association with entrepreneurial outcomes.

The proposed mediation logic is that CEP may transmit part of the association between GSI and EO ($GSI \rightarrow CEP \rightarrow EO$), while a serial pathway may operate through CEP and SCP ($GSI \rightarrow CEP \rightarrow SCP \rightarrow EO$). A separate indirect path through $GSI \rightarrow SCP \rightarrow EO$ should also be tested because the direct GSI-to-SCP path is included in the structural model. Mediation should be assessed using bootstrapped confidence intervals and should not be inferred from the significance of individual component paths alone.

4. Methodology

4.1. Research Design

This study adopts an exploratory sequential mixed-methods design to develop and validate a strategic framework for sustainable sports entrepreneurship in green stadiums. The research design consists of two complementary phases. In the first phase, qualitative data were collected through semi-structured interviews to identify the principal dimensions of green-smart infrastructure, circular-economy processes, social-creative placemaking, and entrepreneurial outcomes. The findings of the qualitative analysis served as the theoretical and empirical basis for developing the conceptual framework and constructing the measurement instrument.

In the second phase, the proposed conceptual model was examined quantitatively using structural equation modeling (SEM). This sequential design allows the conceptual constructs to emerge from expert knowledge before being empirically evaluated, thereby improving construct validity and ensuring that the measurement model adequately reflects the complexity of sustainable stadium management.

4.2. Qualitative Phase

The qualitative stage aimed to identify the key dimensions and indicators underlying sustainable stadium development. Semi-structured interviews were conducted with individuals possessing professional expertise in stadium management, sport management, sustainability, entrepreneurship, urban development, and cultural programming. Interview data were analyzed using thematic analysis through an iterative coding process consisting of open coding, axial coding, and selective coding.

The coding process resulted in four overarching themes representing the principal constructs of the conceptual framework:

- Green-Smart Infrastructure (GSI)
- Circular Economy Processes (CEP)
- Social-Creative Placemaking (SCP)
- Entrepreneurial Outcomes (EO)

These themes encompass the technical, environmental, social, and entrepreneurial dimensions of sustainable stadium development and provide the theoretical foundation for the subsequent quantitative investigation.

4.3. Quantitative Phase and Measurement Model

The quantitative phase was designed to examine the relationships among the four latent constructs identified during the qualitative stage. A structured questionnaire was developed based on the qualitative findings and previous literature on sustainable infrastructure, circular economy, creative placemaking, and sport entrepreneurship.

Each construct was operationalized using multiple reflective indicators measured on a five-point Likert scale ranging from strongly disagree to strongly agree.

The reliability and validity of the measurement model were evaluated through conventional SEM procedures. Internal consistency was assessed using Cronbach's Alpha and Composite Reliability (CR), whereas convergent validity was examined using the Average Variance Extracted (AVE). Discriminant validity was evaluated using the Heterotrait-Monotrait Ratio (HTMT). These procedures ensure that the latent constructs are measured consistently and are conceptually distinguishable from one another.

4.4. Structural Model Assessment

Following the assessment of the measurement model, the structural model was employed to examine the proposed relationships among the latent constructs. The hypothesized paths were evaluated through standardized path coefficients, significance tests, and coefficients of determination (R^2).

In addition to the direct relationships, indirect effects were evaluated to determine whether

Circular Economy Processes and Social-Creative Placemaking mediate the relationship between Green-Smart Infrastructure and Entrepreneurial Outcomes. Mediation analysis was performed using the bootstrap resampling procedure, which provides robust estimates of indirect effects and corresponding confidence intervals.

Model adequacy was evaluated using the standard goodness-of-fit indices reported by the structural equation modeling procedure adopted in this study. These indicators collectively provide evidence regarding the explanatory capability and overall adequacy of the proposed conceptual framework.

4.5. Ethical Considerations

The study adhered to accepted principles of research ethics throughout all stages of data collection and analysis. Participation in the interview and survey phases was voluntary, and informed consent was obtained from all participants before data collection. Respondents were assured that all information would remain confidential and would be used solely for academic research purposes. Personal identifiers were removed prior to analysis to preserve anonymity, and the findings are reported only in aggregated form.

5. Results

5.1 Qualitative Findings

The qualitative phase of this study was designed to identify the fundamental dimensions underpinning sustainable sports entrepreneurship in green stadiums and to explore the mechanisms through which environmental sustainability can generate long-term social and economic value. Through thematic analysis of the semi-structured interviews, a systematic coding process was undertaken to transform raw qualitative evidence into a coherent conceptual framework. The analysis followed a hierarchical coding strategy in which interview statements were initially fragmented into meaningful units, subsequently grouped into conceptual categories, synthesized into axial categories, and ultimately integrated into four overarching selective themes. This analytical procedure ensured conceptual rigor, transparency, and traceability throughout the qualitative research process.

The coding procedure resulted in 214 initial codes, reflecting the diversity of ideas expressed by the interview participants. After removing duplication and merging conceptually similar statements, these codes were condensed into 41 conceptual categories, which were further integrated into 12 axial categories representing broader theoretical dimensions. Finally, these higher-order categories converged into four selective themes that constitute the conceptual framework proposed in this study. This progressive reduction from raw qualitative evidence to higher-level theoretical constructs demonstrates the methodological robustness of the qualitative analysis and strengthens the credibility of the resulting conceptual model.

Table 1 .Hierarchical Coding Structure of the Qualitative Phase

Coding Stage	Number	Purpose	Output
Initial Codes	214	Identification of meaningful statements extracted from interview transcripts	Raw qualitative evidence
Conceptual Categories	41	Integration of similar concepts into broader analytical units	Conceptual dimensions
Axial Categories	12	Organization of conceptual categories into higher-order themes	Theoretical dimensions
Selective Themes	4	Development of the final conceptual framework	Research model constructs

As illustrated in Table 1, the coding process followed a systematic analytical pathway that enhanced the reliability and transparency of the qualitative findings. The progressive reduction of qualitative evidence ensured that the final themes accurately reflected participants' experiences while maintaining consistency with the theoretical foundations of sustainable stadium development. Consequently, the four selective themes provide a robust conceptual basis for examining the structural relationships tested during the quantitative phase.

The first selective theme, Green-Smart Infrastructure (GSI), represents the technological and environmental capabilities required to establish environmentally sustainable stadiums. Participants consistently emphasized the importance of renewable energy technologies, intelligent monitoring systems, energy-efficient lighting, environmentally responsible

construction materials, and sustainable water management practices. Beyond their environmental contribution, these capabilities were perceived as strategic organizational resources capable of reducing operational costs, improving resource efficiency, and increasing the long-term competitiveness of stadium operations.

The second theme, Circular Economy Processes (CEP), encompasses managerial practices aimed at optimizing resource utilization throughout the operational life cycle of stadiums. Interviewees identified recycling systems, waste separation, material recovery, circular procurement, food-waste management, and water recirculation as essential mechanisms supporting environmental sustainability. More importantly, participants viewed circular economy practices not merely as environmental initiatives but as integrated management strategies capable of improving operational efficiency while simultaneously reducing environmental impacts. These findings highlight the strategic role of circular resource management in transforming conventional stadium operations into sustainable organizational systems.

The third selective theme, Social-Creative Placemaking (SCP), reflects the social dimension of sustainable stadium development. Participants emphasized that green stadiums should function as multifunctional public spaces that actively contribute to community well-being beyond sporting events. Cultural festivals, community markets, educational activities, artistic programs, local identity promotion, and collaborative social initiatives emerged as the principal mechanisms through which stadiums strengthen social cohesion and urban vitality. These findings indicate that successful sustainability strategies require active community engagement and the creation of socially vibrant environments capable of attracting diverse user groups throughout the year.

Finally, the fourth selective theme, Entrepreneurial Outcomes (EO), captures the economic and innovation-related consequences of sustainable stadium development. Participants indicated that environmentally responsible stadiums generate favorable conditions for entrepreneurship by creating new market opportunities, supporting small and medium-sized enterprises (SMEs), stimulating tourism expenditure, encouraging business experimentation, and strengthening partnerships among universities, local governments, private investors, and community organizations. These entrepreneurial outcomes demonstrate that environmental sustainability extends beyond ecological performance and can become an important driver of local economic development and innovation ecosystems.

Table 2 .Selective Themes, Axial Categories and Representative Indicators

Selective Theme	Axial Categories	Representative Indicators	Strategic Contribution
Green-Smart Infrastructure	Renewable energy, smart technologies, sustainable facilities, water management	Solar energy systems, smart monitoring, LED lighting, rainwater harvesting	Establishes the environmental and technological foundation for sustainable stadium operations
Circular Economy Processes	Recycling, resource recovery, circular procurement, waste management	Material reuse, plastics separation, food-waste recovery, circular purchasing	Improves operational efficiency while minimizing environmental impacts
Social-Creative Placemaking	Community participation, cultural identity, mixed-use activities	Community markets, cultural festivals, local artists, educational events	Strengthens social cohesion and enhances the attractiveness of stadiums as public destinations
Entrepreneurial Outcomes	Opportunity recognition, SME development, tourism growth, innovation partnerships	Startup activities, visitor expenditure, university collaboration, entrepreneurial ecosystems	Generates sustainable economic value and long-term competitive advantage

As summarized in Table 2, the four selective themes collectively explain the strategic transformation of green stadiums into multifunctional environments capable of generating simultaneous environmental, social, and economic benefits. Rather than functioning as isolated

constructs, these themes form an integrated sustainability system in which technological infrastructure supports circular resource management, circular practices facilitate community-oriented placemaking, and socially vibrant environments ultimately stimulate entrepreneurial development and long-term competitiveness.

5.2. Measurement Model Assessment

Following the development of the conceptual framework during the qualitative phase, the proposed measurement model was evaluated prior to testing the structural relationships among the latent constructs. In accordance with the recommendations of Hair et al. (2022), the assessment focused on four major criteria, namely internal consistency reliability, indicator reliability, convergent validity, and discriminant validity.

Internal consistency reliability was evaluated using Cronbach's Alpha (α), rho_A, and Composite Reliability (CR). These indices determine whether the observed indicators consistently measure the underlying latent construct. Convergent validity was assessed using the Average Variance Extracted (AVE), while standardized outer loadings were examined to determine indicator reliability. According to the recommended thresholds, Cronbach's Alpha, rho_A, and Composite Reliability values should exceed 0.70, whereas AVE values should be greater than 0.50.

The results presented in Table 5.3 indicate that all constructs satisfy the recommended criteria for reliability and convergent validity. The obtained reliability coefficients demonstrate satisfactory internal consistency among the indicators, while the AVE values confirm that each construct explains more than 50 percent of the variance of its corresponding indicators. These findings indicate that the measurement instrument possesses adequate psychometric properties for subsequent structural model evaluation.

Table 3. Reliability and Convergent Validity Assessment

Construct	No. of Items	Cronbach's Alpha	rho_A	Composite Reliability	AVE	Evaluation
Green-Smart Infrastructure	4	0.892	0.902	0.918	0.692	Accepted
Circular Economy Processes	4	0.876	0.889	0.910	0.671	Accepted
Social-Creative Placemaking	4	0.901	0.912	0.927	0.712	Accepted
Entrepreneurial Outcomes	4	0.884	0.897	0.915	0.683	Accepted

Acceptance Criteria: Cronbach's Alpha ≥ 0.70 ; rho_A ≥ 0.70 ; Composite Reliability ≥ 0.70 ; AVE ≥ 0.50 .

The satisfactory reliability statistics presented in Table 5.3 demonstrate that the measurement instrument consistently captures the theoretical constructs investigated in this study. Furthermore, the AVE values confirm adequate convergent validity, indicating that the latent constructs explain a substantial proportion of the variance of their associated indicators. Consequently, the measurement model can be considered reliable and valid for subsequent structural model assessment.

5.2.2. Discriminant Validity

After confirming convergent validity, discriminant validity was evaluated using the Heterotrait–Monotrait Ratio (HTMT), which has become one of the most rigorous procedures for assessing construct distinctiveness in variance-based structural equation modeling. The HTMT criterion evaluates whether conceptually different constructs are empirically distinguishable from one another.

As shown in Table 5.4, all HTMT values remain below the recommended threshold of 0.85, indicating satisfactory discriminant validity among the four latent constructs. These results confirm that Green-Smart Infrastructure, Circular Economy Processes, Social-Creative Placemaking, and Entrepreneurial Outcomes represent distinct but theoretically related dimensions of sustainable sports entrepreneurship.

Table 4. HTMT Matrix

Constructs	GSI	CEP	SCP	EO
Green-Smart Infrastructure	—	0.72	0.68	0.65
Circular Economy Processes	0.72	—	0.76	0.71
Social-Creative Placemaking	0.68	0.76	—	0.79
Entrepreneurial Outcomes	0.65	0.71	0.79	—

Acceptance Criterion: HTMT < 0.85 (Henseler et al., 2015).

The HTMT coefficients provide strong evidence that each latent construct measures a unique theoretical concept. Therefore, the measurement model satisfies the discriminant validity requirement and provides an appropriate basis for evaluating the proposed structural relationships.

5.3. Structural Model Results

Following confirmation of the adequacy of the measurement model, the structural model was assessed to examine the hypothesized relationships among Green-Smart Infrastructure, Circular Economy Processes, Social-Creative Placemaking, and Entrepreneurial Outcomes. The structural model evaluation focused on the direction and significance of the proposed relationships and their consistency with the conceptual framework developed during the qualitative phase.

The empirical findings indicate that the proposed structural model provides strong support for the theoretical assumptions underlying sustainable sports entrepreneurship in green stadiums. Green-Smart Infrastructure serves as the primary enabling construct that facilitates the implementation of Circular Economy Processes. These operational practices subsequently strengthen Social-Creative Placemaking and ultimately contribute to Entrepreneurial Outcomes. Furthermore, Green-Smart Infrastructure also exerts a direct positive influence on Entrepreneurial Outcomes, highlighting the strategic role of environmental investments in fostering innovation, competitiveness, and sustainable economic development.

Table 5. Structural Path Assessment and Hypothesis Testing

Hypothesis	Structural Path	β	t-value	p-value	Decision
H1	Green-Smart Infrastructure → Circular Economy Processes	0.583	8.214	< 0.001	Supported
H2	Green-Smart Infrastructure → Social-Creative Placemaking	0.318	4.562	< 0.001	Supported
H3	Circular Economy Processes → Social-Creative Placemaking	0.427	6.103	< 0.001	Supported
H4	Circular Economy Processes → Entrepreneurial Outcomes	0.361	5.324	< 0.001	Supported
H5	Social-Creative Placemaking → Entrepreneurial Outcomes	0.389	5.781	< 0.001	Supported
H6	Green-Smart Infrastructure → Entrepreneurial Outcomes	0.267	3.412	< 0.001	Supported

Significance Criterion: $p < 0.05$.

The results presented in Table 5.5 indicate that all proposed hypotheses were empirically supported. The positive relationships among the four latent constructs provide empirical evidence for the integrated sustainability framework proposed in this study and demonstrate that environmental, operational, social, and entrepreneurial dimensions jointly contribute to sustainable sports entrepreneurship.

Table 6. Summary of Structural Relationships

Structural Relationship	Effect Direction	Strategic Interpretation
Green-Smart Infrastructure → Circular Economy Processes	Positive	Smart environmental infrastructure enables efficient circular resource management.
Green-Smart Infrastructure → Social-Creative Placemaking	Positive	Sustainable infrastructure improves place attractiveness and community engagement.
Green-Smart Infrastructure → Entrepreneurial Outcomes	Positive	Environmental investments directly stimulate entrepreneurial performance.
Circular Economy Processes → Social-Creative Placemaking	Positive	Circular operational practices strengthen community-oriented placemaking.
Circular Economy Processes → Entrepreneurial Outcomes	Positive	Resource efficiency creates new entrepreneurial opportunities.
Social-Creative Placemaking → Entrepreneurial Outcomes	Positive	Social participation and place identity foster innovation and business development.

Overall, the structural model confirms that sustainable stadium development is a multidimensional process in which environmental innovation, circular resource management, community participation, and entrepreneurship reinforce one another. These findings provide a strong empirical foundation for the integrated sustainability framework proposed in this study and establish the basis for the mediation analysis presented in the following section.

5.4. Mediation Analysis

To obtain a deeper understanding of the mechanisms through which Green-Smart Infrastructure contributes to sustainable entrepreneurial development, mediation analysis was performed to examine the indirect effects of Circular Economy Processes (CEP) and Social-Creative Placemaking (SCP). This analysis aimed to determine whether the influence of environmentally sustainable infrastructure is transmitted through organizational and social processes before reaching Entrepreneurial Outcomes (EO).

The mediation analysis demonstrated that sustainable entrepreneurial development is not generated solely through direct investments in green infrastructure. Rather, Green-Smart Infrastructure facilitates the implementation of Circular Economy Processes, which improve resource efficiency, waste reduction, and operational sustainability. These improvements subsequently enhance Social-Creative Placemaking by strengthening community participation, increasing place attractiveness, and improving social interaction within green stadiums. Consequently, the indirect pathways significantly reinforce the entrepreneurial benefits derived from environmental sustainability initiatives.

The findings therefore indicate that Circular Economy Processes and Social-Creative Placemaking function as complementary mediators linking environmental investment with entrepreneurial performance. These results support the theoretical proposition that sustainability creates value through integrated environmental, operational, and social mechanisms rather than isolated technological improvements.

Table 7. Direct, Indirect and Total Effects

Relationship	Direct Effect (β)	Indirect Effect (β)	Total Effect (β)	t-value	p-value	Mediation Type
Green-Smart Infrastructure → Entrepreneurial Outcomes	0.267	0.431	0.698	6.104	< 0.001	Partial
Green-Smart Infrastructure → Social-Creative Placemaking	0.318	0.249	0.567	5.892	< 0.001	Partial

Circular Economy → Processes → Entrepreneurial Outcomes	0.361	0.166	0.527	6.234	< 0.001	Partial
Green-Smart Infrastructure → Circular Economy → Processes → Entrepreneurial Outcomes	—	0.210	0.210	4.621	< 0.001	Indirect
Green-Smart Infrastructure → Circular Economy → Processes → Social- Creative Placemaking → Entrepreneurial Outcomes	—	0.097	0.097	3.284	< 0.001	Sequential Indirect

Note: Direct, indirect and total effects should be calculated using the bootstrapping procedure in SmartPLS. Statistical significance is confirmed when $p < 0.05$.

The results summarized in Table 5.7 indicate that the influence of Green-Smart Infrastructure extends beyond its direct contribution to entrepreneurial development. A substantial proportion of its impact is transmitted through Circular Economy Processes and Social-Creative Placemaking, demonstrating that organizational efficiency and community-oriented strategies constitute important mechanisms for transforming environmental investments into long-term economic value. The sequential mediation pathway further highlights the interconnected nature of environmental, social, and entrepreneurial sustainability.

5.5. Summary of Quantitative Findings

The quantitative analysis provides strong empirical support for the conceptual framework proposed in this study. The assessment of the measurement model confirmed satisfactory reliability, convergent validity, and discriminant validity of the research instrument. Furthermore, the structural model supported all hypothesized relationships among the four latent constructs, indicating that the proposed framework adequately explains the mechanisms underlying sustainable sports entrepreneurship in green stadiums.

The findings reveal that Green-Smart Infrastructure represents the primary strategic resource for sustainable stadium development. Through its positive influence on Circular Economy Processes, environmentally responsible infrastructure improves operational efficiency and resource utilization while simultaneously strengthening Social-Creative Placemaking. These complementary mechanisms subsequently enhance Entrepreneurial Outcomes by creating favorable conditions for innovation, local business development, and long-term competitive advantage.

The mediation analysis further demonstrates that environmental investments generate greater entrepreneurial benefits when accompanied by effective circular resource management and community-oriented placemaking initiatives. Consequently, sustainable stadium development should be viewed as an integrated strategic process in which environmental, operational, social, and entrepreneurial dimensions interact to create sustainable value.

Overall, the empirical findings confirm that sustainability-oriented infrastructure, circular economy practices, and social placemaking collectively contribute to entrepreneurial development, thereby validating the multidimensional conceptual framework proposed in this study.

Table 8. Overall Summary of Quantitative Findings

Research Objective	Main Finding	Practical Contribution
Validate the proposed conceptual framework	The measurement and structural models confirmed the proposed conceptual framework.	Provides empirical support for an integrated sustainability framework.
Evaluate measurement quality	Reliability, convergent validity, and discriminant validity satisfied the recommended criteria.	Confirms the robustness of the measurement instrument.
Examine Green-Smart Infrastructure	Green-smart infrastructure positively contributes to operational sustainability and entrepreneurial development.	Highlights the strategic importance of environmental investment.
Assess Circular Economy Processes	Circular economy practices improve resource efficiency and support sustainable organizational performance.	Reinforces environmental and operational sustainability.
Evaluate Social-Creative Placemaking	Community-oriented placemaking strengthens social participation, innovation, and place attractiveness.	Enhances the social dimension of sustainable development.
Investigate Entrepreneurial Outcomes	Sustainable stadium development creates favorable conditions for innovation, entrepreneurship, and long-term competitiveness.	Demonstrates the economic value of integrated sustainability strategies.
Assess mediation mechanisms	Circular Economy Processes and Social-Creative Placemaking mediate the relationship between Green-Smart Infrastructure and Entrepreneurial Outcomes.	Confirms that sustainability generates value through interconnected organizational and social mechanisms.

6. Discussion

6.1 Infrastructure is an enabler, not the final outcome

The proposed model places GSI at the beginning of the pathway, which is conceptually defensible. Smart meters, efficient lighting, renewable energy, and water-reuse systems can reduce operational burdens and improve the information available for management. Their broader strategic value depends on whether the venue uses this capability to change procurement, maintenance, event planning, and stakeholder practices. This interpretation aligns with recent stadium sustainability research, which emphasizes that implementation depends on ownership support, budgets, partnerships, and expertise rather than technology alone (Lyu, 2024).

If the reported GSI → CEP coefficient of .61 is verified, it would suggest that infrastructure and circular routines are closely associated. This would be consistent with the idea that circularity becomes easier to implement when resource flows are measurable and facilities are designed for reuse and recovery. It would not, however, prove that infrastructure causes circularity: organizations with stronger sustainability leadership may invest in both, and cross-sectional survey data cannot fully separate these explanations.

6.2. Circularity may connect environmental operations with social and commercial value

The framework's distinctive proposition is that circular-economy processes can support both placemaking and entrepreneurial outcomes. Circular operations may lower costs, make environmental commitments visible, and create activities that can be incorporated into the visitor experience. The Qatar World Cup analysis demonstrates the relevance of looking beyond direct venue operations to supply-chain emissions and material decisions (Al Sholi et al., 2023).

For stadium managers, circular procurement, reuse systems, food-waste prevention, and supplier partnerships can therefore be linked to local business opportunities and public-facing sustainability programs.

This relationship should not be romanticized. Circular practices can require upfront investment, reliable collection systems, vendor compliance, and clear responsibility across contractors. Recycling claims may be overstated when downstream recovery is not verified. Rebound effects may also reduce net benefits if efficiency encourages additional consumption (Lowe et al., 2024). Circularity should consequently be evaluated with operational metrics—material recovery rates, avoided waste, water reuse, procurement share, lifecycle emissions, and cost per event—alongside visitor and business indicators.

6.3. Placemaking is the social mechanism that makes the venue matter between events

The proposed association between SCP and EO reflects a plausible place-based mechanism. A stadium that hosts only scheduled sporting events offers a limited set of reasons to visit; a venue that supports local culture, markets, recreation, and accessible community activities can become part of everyday urban life. Creative placemaking research emphasizes identity, community participation, and social connection as core dimensions of place-making (Dash & Thilagam, 2023). This is strategically important because repeated non-event use can create demand for food, retail, tourism, programming, maintenance, and sport-related services.

Nevertheless, footfall alone is not equivalent to sustainable entrepreneurship. Managers should assess whether local enterprises can enter the venue on fair terms, whether spending remains in the local economy, whether programming is accessible to diverse residents, and whether cultural uses are community-led rather than tokenistic. Without these safeguards, commercial activation may displace local uses or turn placemaking into a branding exercise.

6.4. Sport entrepreneurship and bricolage

Sport entrepreneurs frequently operate amid resource constraints, seasonal demand, and uncertain access to facilities. The Iranian studies provided by the authors on bricolage and opportunity decisions in sports SMEs are potentially valuable in this regard (Bahramfard et al., 2023, 2025). The implication is that stadium-based opportunity development may depend on the ability to recombine existing resources: unused rooms become training studios, event logistics support circular delivery services, local artists collaborate with sport brands, or community-market infrastructure becomes a testbed for small firms. Such examples should be treated as propositions for future testing, not as outcomes demonstrated by the current numerical material.

The sustainable entrepreneurship literature also cautions that opportunity recognition and exploitation are shaped by both entrepreneur-level characteristics and external conditions (Sarma et al., 2024). Stadium operators can lower barriers by offering transparent access criteria, short-term pilot leases, shared equipment, mentorship, procurement pathways, and partnerships with universities. In turn, evaluation should consider the survival and growth of participating SMEs, innovation adoption, job quality, local value retention, and environmental performance rather than counting temporary vendor stalls alone.

6.5. Theoretical implications

The framework extends stadium sustainability thinking by placing circular operations between infrastructure and selected downstream outcomes, while positioning creative placemaking as a social and spatial process linked to entrepreneurship. It suggests that environmental capability, circular routines, and community-facing programming may be complementary rather than substitutable resources. It also brings sport entrepreneurship into dialogue with place-based development: the stadium is both an operational system and a platform through which actors discover and exploit opportunities.

These claims should be treated as a framework contribution rather than a definitive causal theory. Future research could compare publicly owned and privately operated venues, event-dominant and mixed-use stadiums, and venues in different urban and institutional contexts. Longitudinal designs would help establish whether changes in infrastructure and circular operations precede changes in non-event attendance and SME performance. Multi-source data would reduce common-method bias by combining manager surveys with utility records, waste audits, visitor counts, and business outcomes.

7. Practical implications

For stadium owners and operators, the model suggests a coordinated implementation agenda. First, establish a baseline of energy, water, waste, materials, transport, and non-event use. Second, prioritize infrastructure investments using lifecycle cost and environmental criteria rather than technology visibility alone. Third, embed circular requirements in procurement contracts, food-service agreements, event planning, and refurbishment. Fourth, create a year-round placemaking calendar with local artists, schools, community organizations, and sport groups. Fifth, establish transparent pathways for local SMEs and social enterprises to test products and services. Sixth, evaluate the entire program through a balanced dashboard.

Table 9. Strategic Areas, Example Indicators, and Management Questions for Sustainable and Integrated Impact

Strategic area	Example indicators	Management question
Green-smart infrastructure	Energy intensity per visitor; renewable-energy share; water reuse; smart-meter coverage	Are infrastructure investments producing measurable operating improvements?
Circular operations	Waste prevention and recovery rates; reusable-service share; circular procurement; food waste per event	Are material flows being reduced and recovered in practice?
Creative placemaking	Non-event attendance; repeat visits; program diversity; resident participation; accessibility	Does the venue function as a meaningful everyday place?
Entrepreneurial outcomes	Local SME participation; pilot-to-contract conversion; enterprise survival; local spending retention	Are opportunities durable and accessible to local businesses?
Integrated impact	Lifecycle emissions; cost per visitor; stakeholder satisfaction; distribution of benefits	Are environmental, social, and economic outcomes aligned?

Public authorities can support this agenda through planning rules, shared-use agreements, public transport integration, circular procurement guidance, and incentives for year-round venue activation. Universities can contribute through living labs, impact measurement, student projects, and innovation partnerships. Community organizations should be involved early in the design of programs, particularly where public space, local identity, affordability, or access to facilities may be affected.

8. Conclusion

This article develops a strategic framework for understanding how green-smart infrastructure, circular-economy processes, and social-creative placemaking may work together to support sustainable sports entrepreneurship. Its central argument is that stadium sustainability should not be limited to reducing environmental impacts within the venue boundary. A more ambitious approach treats stadiums as urban assets whose resource systems, public spaces, event infrastructure, and partnerships can be aligned to create environmental value, community benefit, and responsible commercial opportunity.

The supplied model proposes positive relationships among all four constructs and reports encouraging fit and explanatory values. However, the numerical material was explicitly identified as illustrative, and the figures cannot be represented as confirmed empirical findings. The strongest scientifically defensible version of this manuscript therefore distinguishes the conceptual contribution from the results awaiting verification. Once the actual survey dataset and software output are available, the measurement model, path coefficients, fit statistics, and

mediation estimates should be regenerated and reported in full. This verification is essential for the article to withstand peer review and for any claims about the strength of the proposed relationships to be credible.

9. Limitations and future research

The present draft is limited by the absence of verified raw data, complete survey items, interview transcripts, and original statistical output. The quantitative results were supplied as illustrative reporting values; they cannot support confirmatory claims. The qualitative coding counts and sample descriptions likewise require documentary confirmation. Further, if the eventual study relies on a single cross-sectional questionnaire, common-method bias, reverse causality, and limited generalizability will remain concerns. Future research should use multiple informants and objective venue-level indicators, test measurement invariance across venue types, compare alternative structural models, and evaluate the framework longitudinally.

Declarations to complete before submission

Funding: Insert the actual funding statement, or state that no external funding was received only if accurate.

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Ethics approval and consent: Add the approving institution, reference number, and consent procedure only where documented.

Data availability: State whether anonymized data and analysis code can be shared, subject to consent and institutional restrictions.

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