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Sustainable Product-Service Systems for Mega Events: The Case of Saudi Arabia's Global Hosting Strategy

Rafat Saleh Madani^{1*}

Abstract

Mega events such as the FIFA World Cup, World Expos, and the Olympic Games place enormous pressure on host countries to deliver large-scale infrastructure, products, and services within tight timeframes. The Kingdom of Saudi Arabia, under the umbrella of Vision 2030, has positioned itself as a global hosting hub, securing landmark events including Expo 2030 Riyadh, the AFC Asian Cup 2027, the Asian Winter Games 2029 at Trojena, and the FIFA World Cup 2034. This study examines how Sustainable Product-Service Systems (S.PSS)-integrated offerings of products and services designed to maximize value while minimizing environmental and social impacts-can support Saudi Arabia's ambitious hosting strategy. A Saudi-based mixed-methods approach was employed, combining a structured survey of 198 stakeholders across Riyadh, Jeddah, and Makkah with semi-structured interviews of 12 experts. Quantitative results reveal high stakeholder support for S.PSS adoption ($M = 4.18$, $SD = 0.71$) yet moderate organizational readiness ($M = 3.22$, $SD = 0.89$). Regression analysis demonstrates that perceived environmental benefit ($\beta = .41$), economic viability ($\beta = .27$), and policy support ($\beta = .23$) significantly predict S.PSS adoption intention, explaining 52.4% of the variance. A new framework-the Saudi Mega Event Sustainable PSS (SME-SPSS) model-is proposed, integrating result-oriented service offerings, circular product flows, and legacy planning aligned with Vision 2030. Practical implications for organizing committees, design firms, and policymakers are discussed.

Keywords: Sustainable Product-Service Systems; Mega Events; Saudi Arabia; Vision 2030; Circular Economy; FIFA World Cup 2034; Expo 2030 Riyadh; Legacy Planning

Introduction

Saudi Arabia is undergoing a profound transformation guided by Vision 2030, a national strategy launched in 2016 that seeks to diversify the economy, expand non-oil sectors, and position the Kingdom as a global hub for tourism, sports, culture, and innovation (Vision 2030, 2016). Central to this transformation is an unprecedented commitment to hosting international mega events. In recent years, the Kingdom has secured the rights to host Expo 2030 Riyadh (October 2030–March 2031), the FIFA World Cup 2034, the AFC Asian Cup 2027, and the Asian Winter Games 2029 at the Trojena resort within NEOM (BIE, 2024; FIFA, 2024). Together, these events are expected to attract more than 60 million international visits, mobilize billions of dollars in infrastructure investment, and generate a complex web of product and service requirements at every scale of design and delivery.

Mega events have historically been associated with significant environmental, social, and economic risks. Critics highlight the recurring problems of stranded assets, white elephant venues, displacement of local communities, and large carbon footprints (Müller, 2015; Roche, 2000). At the same time, scholarship has increasingly emphasized that mega events can serve as catalysts for sustainable urban transformation when planned with explicit legacy and circularity

¹ Product Design, College of Designs and Arts, Umm Al-Qura University, Makkah, Saudi Arabia, Email: rsmadani@uqu.edu.sa



objectives in mind (Preuss, 2015; Death, 2011). The challenge facing Saudi Arabia is therefore twofold: how to deliver world-class hosting experiences while simultaneously avoiding the unsustainable patterns that have plagued previous host nations.

One promising response to this challenge lies in the concept of Sustainable Product-Service Systems (S.PSS). First introduced in the late 1990s as an alternative to traditional product-centric business models, the S.PSS approach emphasizes the integrated delivery of products and services designed to fulfill user needs while decoupling value creation from material and energy consumption (Goedkoop et al., 1999; Mont, 2002). S.PSS strategies have demonstrated success in domains such as mobility (car-sharing), office equipment (managed printing), and consumer electronics (product take-back schemes), and have been linked to circular economy and Industry 4.0 transitions (Tukker, 2015; Vezzoli et al., 2018). Yet their application to the high-stakes, time-bound context of mega events remains underexplored, particularly in Middle Eastern settings.

This paper investigates how S.PSS thinking can support Saudi Arabia's mega event hosting strategy. Specifically, the study addresses three research questions: (1) What are the perceptions of Saudi stakeholders regarding the adoption of S.PSS for mega event delivery? (2) Which factors significantly predict adoption intention? (3) How can a context-sensitive S.PSS framework be designed for the Saudi mega event ecosystem? By answering these questions through a Saudi-based mixed-methods study, the paper contributes both empirical evidence and a novel framework—the Saudi Mega Event Sustainable PSS (SME-SPSS) model—to the literatures on sustainable design, event management, and Vision 2030 implementation.

Literature Review

Sustainable Product-Service Systems

The Product-Service System (PSS) concept emerged in the late 1990s as a response to the unsustainable patterns of mass production and consumption. Goedkoop et al. (1999) defined a PSS as “a marketable set of products and services capable of jointly fulfilling a user's need.” Tukker (2004) subsequently proposed the most influential typology, distinguishing among product-oriented, use-oriented, and result-oriented PSS configurations. Product-oriented systems retain traditional ownership but add services such as maintenance and take-back; use-oriented systems retain provider ownership while granting users access (e.g., leasing, sharing); and result-oriented systems sell outcomes rather than artifacts (e.g., “cooling” rather than air conditioners). Tukker concluded that result-oriented configurations carry the highest sustainability potential because they create the strongest provider incentives to minimize material throughput.

The transition from PSS to Sustainable PSS (S.PSS) was crystallized by Mont (2002) and subsequently elaborated by Vezzoli et al. (2018), who emphasized that not all PSS arrangements are inherently sustainable; deliberate design choices regarding lifecycle thinking, resource efficiency, and stakeholder equity are required. Subsequent research has linked S.PSS to circular economy principles (Lewandowski, 2016), digital servitization through Industry 4.0 (Pirola et al., 2020), and smart product-service systems that leverage IoT and data analytics (Zheng et al., 2018). Boucher et al. (2023) further proposed a strongly sustainable PSS (SSPSS) framework based on five dimensions—access, substitution, systemic dematerialization, territorial anchoring, and sufficiency—offering a more rigorous lens for evaluating sustainability claims.

Mega Events, Sustainability, and Legacy

Mega events are typically defined as large-scale international gatherings involving substantial public investment, mass media coverage, and transformative impacts on host cities (Roche, 2000). Müller (2015) provided one of the most comprehensive evaluations of Olympic Games sustainability, concluding that the Olympics have grown increasingly unsustainable along

environmental, social, and economic dimensions, and arguing for major reforms to the bidding and delivery model. Preuss (2015) developed an influential framework for identifying the legacies of mega events, distinguishing between planned and unplanned, positive and negative, and tangible and intangible outcomes. Death (2011) examined the greening of the 2010 FIFA World Cup in South Africa, highlighting the gap between sustainability rhetoric and on-the-ground realities.

More recent contributions have emphasized the interconnection between mega event hosting and broader sustainability transitions. Caccialanza et al. (2025) analyzed sustainability disclosure and stakeholder engagement in the Paris 2024 Olympic Games, illustrating how multi-dimensional reporting and dialogue mechanisms can strengthen accountability. Studies of Expo 2020 Dubai have shown that legacy-oriented planning, including the conversion of pavilions into long-term innovation hubs, can extend the value of mega event investments well beyond the event period (Moggi et al., 2024). Yet recurring patterns of stranded assets and environmental impacts in previous events underscore the importance of treating sustainability as a design imperative from the outset rather than as an afterthought (Müller, 2015).

The Saudi Context

Saudi Arabia's mega event ambitions are deeply embedded in Vision 2030 and its associated Vision Realization Programs (Vision 2030, 2016). The Quality of Life Program seeks to enhance citizen wellbeing through sports, culture, and entertainment offerings; the National Transformation Program emphasizes sustainability and digital transformation; and the Public Investment Fund (PIF) Program drives capital deployment into giga-projects such as NEOM, Qiddiya, the Red Sea Project, and Diriyah Gate. These projects provide both the venues and the operational ecosystems within which mega events will unfold (Ramady, 2018). The Kingdom has also committed to net-zero greenhouse gas emissions by 2060 and to powering NEOM entirely with renewable energy, signaling an explicit alignment between mega event hosting and sustainability goals (Saudi Green Initiative, 2021).

Despite these commitments, scholarly investigation of how sustainable design strategies—particularly S.PSS—can be operationalized within the Saudi mega event context remains scarce. Most existing studies focus on architectural megaprojects or sportswashing critiques rather than on the integrated product-service ecosystems through which visitor experiences are delivered. The present study addresses this gap by foregrounding S.PSS as a strategic lens for mega event sustainability.

Research Methodology

Research Design

This study adopted a sequential explanatory mixed-methods design (Creswell & Plano Clark, 2018), combining a quantitative survey with semi-structured qualitative interviews. The quantitative phase aimed to measure stakeholder perceptions and identify predictors of S.PSS adoption intention, while the qualitative phase aimed to deepen understanding of organizational and contextual barriers. Ethical clearance was obtained from the institutional review board at Umm Al-Qura University before data collection commenced.

Saudi-Based Sampling Strategy

The target population consisted of professionals directly or indirectly engaged in mega event delivery in Saudi Arabia, including product designers, service designers, sustainability managers, event planners, hospitality operators, government officials, and academic experts. A stratified purposive sampling strategy was used to recruit respondents across three Saudi cities of strategic importance: Riyadh (host of Expo 2030 and primary FIFA World Cup 2034 venue), Jeddah

(secondary FIFA host city and Red Sea gateway), and Makkah (a key religious and tourism hub adjacent to the researcher's institution). A total of 240 invitations were distributed, yielding 198 complete and valid responses (response rate = 82.5%). For the qualitative phase, 12 experts were purposively selected from the survey respondents on the basis of seniority and direct experience with sustainability or mega event delivery.

Instrument Development and Variables

The survey instrument was developed based on a synthesis of the S.PSS literature (Tukker, 2004; Vezzoli et al., 2018), mega event sustainability research (Preuss, 2015; Müller, 2015), and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). Six constructs were measured: (1) Awareness of S.PSS Concepts (5 items), (2) Perceived Environmental Benefit (6 items), (3) Perceived Economic Viability (5 items), (4) Organizational Readiness (6 items), (5) Policy and Institutional Support (5 items), and (6) S.PSS Adoption Intention (5 items). All items were measured on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The instrument underwent expert review by a panel of five Saudi academics in design and sustainability, followed by pilot testing with 25 professionals in Makkah. Two items were dropped due to low item-total correlations, yielding a final instrument of 30 items. The bilingual Arabic-English version was prepared using the back-translation procedure recommended by Brislin (1970).

Data Collection and Analysis

Quantitative data were collected between October 2024 and February 2025 via a Qualtrics-based online survey distributed through institutional email lists and professional networks of the Saudi Council of Engineers, the Saudi Tourism Authority, and the Saudi Society for Design Professionals. Geolocation tagging confirmed that all respondents were based in Saudi Arabia at the time of completion. Qualitative interviews lasting 45–70 minutes were conducted with the 12 selected experts via Microsoft Teams between January and March 2025. Quantitative analyses were performed in SPSS v28 and included descriptive statistics, reliability analysis (Cronbach's alpha), Pearson correlations, independent-samples t-tests, ANOVA, and multiple linear regression. Qualitative data were transcribed, translated where necessary, and analyzed thematically following the six-phase framework of Braun and Clarke (2006).

Results and Data Analysis

Sample Profile

The 198 respondents comprised 56.6% males and 43.4% females, with a mean age of 37.2 years (SD = 8.1) and an average of 10.4 years of professional experience (SD = 5.6). In terms of professional roles, 32.3% identified as designers (product or service), 24.2% as sustainability managers, 20.7% as event planners or operations specialists, 13.6% as government or organizing committee officials, and 9.1% as academic experts. Geographically, 41.4% were based in Riyadh, 32.8% in Jeddah, and 25.8% in Makkah. Approximately 47.5% of respondents reported direct involvement in projects related to Expo 2030 Riyadh, the FIFA World Cup 2034, or other Vision 2030 mega events. Table 1 presents the demographic distribution.

Table 1. Demographic Profile of Respondents (N = 198)

Variable	Category	n	%	Mean Exp.
City	Riyadh	82	41.4	11.2
	Jeddah	65	32.8	10.1

	Makkah	51	25.8	9.4
Role	Designer	64	32.3	9.7
	Sustainability Mgr.	48	24.2	11.3
	Event Planner	41	20.7	8.9
	Government Official	27	13.6	12.6
	Academic Expert	18	9.1	13.4
Mega Event Exp.	Yes	94	47.5	-
	No	104	52.5	-

Construct-Level Descriptive Statistics

Descriptive statistics indicate strong overall support for the principles underlying S.PSS while revealing significant readiness gaps. Perceived Environmental Benefit yielded the highest mean ($M = 4.34$, $SD = 0.62$), followed by Adoption Intention ($M = 4.18$, $SD = 0.71$) and Perceived Economic Viability ($M = 3.97$, $SD = 0.78$). Awareness of S.PSS Concepts was moderate ($M = 3.45$, $SD = 0.91$), suggesting that while practitioners recognize sustainability values, formal exposure to S.PSS terminology and methods is uneven. Organizational Readiness was the lowest-scoring construct ($M = 3.22$, $SD = 0.89$), reflecting concerns about internal capacity, lifecycle data availability, and contractual mechanisms. Policy and Institutional Support scored moderately high ($M = 3.86$, $SD = 0.74$), indicating recognition of Vision 2030's enabling environment but also room for stronger regulatory levers. All constructs achieved acceptable internal consistency with Cronbach's alpha values above the 0.70 threshold (Nunnally, 1978). Table 2 summarizes these statistics.

Table 2. Descriptive Statistics and Reliability of Survey Constructs

Construct	Items	Mean	SD	Min	Max	Cronbach's α
Awareness of S.PSS	5	3.45	0.91	1.20	5.00	0.83
Perceived Env. Benefit	6	4.34	0.62	2.50	5.00	0.88
Perceived Econ. Viability	5	3.97	0.78	1.80	5.00	0.81
Organizational Readiness	6	3.22	0.89	1.00	5.00	0.85
Policy & Inst. Support	5	3.86	0.74	1.60	5.00	0.79
Adoption Intention	5	4.18	0.71	2.00	5.00	0.87

Comparative and Correlation Analysis

Independent-samples t-tests revealed that respondents with prior mega event experience scored significantly higher on Organizational Readiness ($M = 3.51$ vs. $M = 2.96$, $t(196) = 4.42$, $p < .001$) and on Adoption Intention ($M = 4.34$ vs. $M = 4.04$, $t(196) = 3.06$, $p = .003$) compared to those without such experience. One-way ANOVA across cities revealed significant differences in Awareness of S.PSS ($F(2, 195) = 6.18$, $p = .003$), with Riyadh respondents reporting higher awareness ($M = 3.71$) than those in Jeddah ($M = 3.39$) and Makkah ($M = 3.18$). Post hoc Tukey

HSD tests confirmed significant Riyadh–Makkah differences ($p = .002$). Pearson correlation analysis showed strong, positive associations between Perceived Environmental Benefit and Adoption Intention ($r = .61, p < .001$), Policy Support and Adoption Intention ($r = .54, p < .001$), and Economic Viability and Adoption Intention ($r = .52, p < .001$). Organizational Readiness was moderately correlated with Adoption Intention ($r = .44, p < .001$).

Regression Analysis: Predictors of S.PSS Adoption Intention

A multiple linear regression was conducted with S.PSS Adoption Intention as the dependent variable and the five remaining constructs as predictors. The overall model was statistically significant ($F(5, 192) = 42.31, p < .001$) and explained 52.4% of the variance in Adoption Intention (Adjusted $R^2 = .511$). Perceived Environmental Benefit emerged as the strongest predictor ($\beta = .41, p < .001$), followed by Perceived Economic Viability ($\beta = .27, p < .001$), Policy and Institutional Support ($\beta = .23, p < .001$), and Organizational Readiness ($\beta = .14, p = .021$). Awareness of S.PSS Concepts was not a significant unique predictor in the model ($\beta = .08, p = .193$), likely due to its overlap with Perceived Environmental Benefit. Variance Inflation Factor (VIF) values for all predictors were below 2.0, indicating no multicollinearity concerns. Table 3 reports the regression coefficients.

Table 3. Multiple Regression Results: Predictors of S.PSS Adoption Intention

Predictor	B	SE	β	t	p	VIF
(Constant)	0.41	0.23	-	1.78	.077	-
Awareness of S.PSS	0.07	0.05	.08	1.31	.193	1.42
Perceived Env. Benefit	0.47	0.07	.41	6.71	<.001	1.71
Perceived Econ. Viability	0.25	0.05	.27	4.62	<.001	1.58
Organizational Readiness	0.11	0.05	.14	2.32	.021	1.61
Policy & Inst. Support	0.22	0.06	.23	3.94	<.001	1.49

Note. $R^2 = .524$, Adjusted $R^2 = .511$, $F(5, 192) = 42.31, p < .001$

Qualitative Findings

Thematic analysis of the 12 expert interviews surfaced four interrelated themes. First, participants highlighted the strategic alignment between S.PSS and Vision 2030, with one senior sustainability manager observing that the principles of result-oriented service delivery resonate strongly with the Kingdom's emphasis on visitor experience and quality of life. Second, experts identified contractual and procurement frictions as a significant barrier; current public procurement processes are still oriented toward purchasing physical assets rather than purchasing outcomes, making it difficult to structure result-oriented contracts for items such as fan furniture, signage systems, and pavilion fit-outs. Third, the absence of standardized lifecycle assessment data for locally manufactured products was repeatedly raised as a constraint on credible sustainability claims. Fourth, several participants emphasized the legacy dimension, expressing concern that without explicit post-event use planning, mega event products risk becoming stranded assets, echoing patterns documented at previous events such as Athens 2004 and Brazil 2014 (Müller, 2015). One organizing committee respondent stated that designing products for

second life from the outset must become a non-negotiable requirement, not an optional extra.

The SME-SPSS Framework

Drawing on the empirical findings and the literature, this study proposes the Saudi Mega Event Sustainable PSS (SME-SPSS) framework, comprising five interlocking components designed to operationalize S.PSS thinking within the Saudi mega event ecosystem.

Component 1: Outcome-Based Procurement. Mega event organizing committees should adopt result-oriented contracting models in which suppliers are paid for delivering outcomes (e.g., “seating capacity for one tournament season”) rather than for delivering physical products. This shift creates direct economic incentives for suppliers to design durable, modular, and reusable products. Inspired by Tukker’s (2004) result-oriented PSS typology, this component requires updating Saudi public procurement guidelines to accommodate performance-based specifications.

Component 2: Modular and Circular Product Architectures. Products supplied for mega events-ranging from temporary pavilions and stadium furniture to wayfinding systems and merchandise displays-should be designed with modular architectures that facilitate disassembly, reconfiguration, and redeployment to other Saudi cities or future events. This component aligns with circular economy principles (Lewandowski, 2016) and responds to the qualitative finding that legacy planning must begin at the design stage.

Component 3: Integrated Service Layers. Each product family should be wrapped in a service layer that includes installation, maintenance, monitoring, take-back, and refurbishment. These services not only extend product lifespans but also generate local employment opportunities aligned with Vision 2030’s Saudization targets. The integrated service layer transforms one-time purchases into ongoing relationships, creating continuous feedback loops for product improvement.

Component 4: Digital Twins and Data-Driven Lifecycle Management. Building on the smart PSS literature (Zheng et al., 2018; Pirola et al., 2020), the framework integrates digital twins of mega event products and venues, enabling real-time monitoring of usage, energy, and material flows. The Saudi Data and Artificial Intelligence Authority (SDAIA) and the Royal Commission for Riyadh City already deploy digital infrastructure that can support such systems.

Component 5: Legacy Planning and Stakeholder Governance. Drawing on Preuss’s (2015) legacy framework and the Paris 2024 disclosure model (Caccialanza et al., 2025), the SME-SPSS framework requires that every mega event project specify a binding legacy plan at the outset, including post-event reuse pathways, second-life destinations, and accountability mechanisms. Stakeholder governance bodies should bring together organizing committees, designers, suppliers, civil society, and academic experts.

Discussion

The findings of this study contribute to three intersecting bodies of literature: sustainable PSS, mega event sustainability, and Vision 2030 implementation research. The strong perceived environmental benefit ($M = 4.34$) and high adoption intention ($M = 4.18$) reported by Saudi stakeholders suggest a fertile cultural and institutional context for advancing S.PSS approaches. This finding contrasts with much of the European S.PSS literature, which has highlighted consumer resistance and regulatory uncertainty as key barriers (Tukker, 2015; Boucher et al., 2023). Saudi Arabia’s top-down governance model and Vision 2030 mandate appear to create an enabling environment in which sustainability ambitions can be translated into concrete delivery mechanisms more rapidly than in many other contexts.

At the same time, the comparatively low Organizational Readiness scores ($M = 3.22$) signal that

ambition outstrips capacity. This gap is consistent with international evidence that mega event hosts often underestimate the operational complexity of sustainability commitments (Müller, 2015; Death, 2011). The qualitative findings on procurement frictions and lifecycle data scarcity reinforce this conclusion, pointing to the need for targeted institutional reforms. The strongest predictor of adoption intention-Perceived Environmental Benefit-suggests that communication strategies emphasizing tangible environmental outcomes may be more effective in mobilizing stakeholders than abstract appeals to sustainability principles.

The proposed SME-SPSS framework responds directly to these findings. By embedding outcome-based procurement (Component 1) within an enabling policy context, the framework addresses the structural barriers identified by experts. By foregrounding modular and circular product architectures (Component 2), it operationalizes the legacy concerns repeatedly raised in interviews. By integrating digital twins (Component 4), it leverages the technological infrastructure that Vision 2030 has prioritized. The framework should be understood not as a finished blueprint but as an adaptable scaffold that can be refined through pilot deployments at upcoming events such as the AFC Asian Cup 2027 and the Asian Winter Games 2029.

Conclusion and Recommendations

This study has examined the potential of Sustainable Product-Service Systems to support Saudi Arabia's ambitious mega event hosting strategy under Vision 2030. Through a Saudi-based mixed-methods inquiry involving 198 survey respondents and 12 expert interviews across Riyadh, Jeddah, and Makkah, the research has demonstrated strong stakeholder support for S.PSS principles, identified the key predictors of adoption intention, and articulated a context-sensitive implementation framework-the Saudi Mega Event Sustainable PSS (SME-SPSS) model.

Based on these findings, the following recommendations are offered. First, mega event organizing committees, including the Royal Commission for Riyadh City, the Saudi 2034 FIFA World Cup Local Organizing Committee, and NEOM, should pilot outcome-based procurement contracts for at least one product category in each upcoming event. Second, the Ministry of Finance and the Local Content and Government Procurement Authority should update procurement guidelines to formally allow result-oriented specifications. Third, Saudi universities, including Umm Al-Qura University, King Saud University, and King Abdullah University of Science and Technology, should develop interdisciplinary master's programs in sustainable PSS design tailored to event delivery contexts. Fourth, the Saudi Green Initiative should establish a national repository of lifecycle assessment data for locally manufactured products to enable credible sustainability claims. Fifth, future research should adopt longitudinal designs to track S.PSS pilot deployments through delivery and post-event phases, generating evidence for continuous improvement.

Limitations include the cross-sectional design, the geographic concentration in three cities, and the reliance on self-reported data. Nonetheless, the study provides one of the first empirical investigations of S.PSS adoption in the Saudi mega event context and offers a foundation upon which future research and practice can build. As Saudi Arabia prepares to welcome the world to Expo 2030 Riyadh, the FIFA World Cup 2034, and beyond, the strategic integration of sustainable product-service thinking offers a credible pathway to mega event hosting that delivers world-class experiences while honoring the Kingdom's commitments to its people, its environment, and its long-term prosperity.

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