Engineering Innovations as Determinants of Sustainable Sports Infrastructure and Event Management Performance in Nigeria

A Comparison with Global Best Practices

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Innovations for Sustainable Development and Resilient Infrastructure

Introduction and Background

Three principal problems

Weak maintenance culture
Repairs follow failure instead of a plan

Design ignores long-term cost
Whole-life costs are left out of decisions

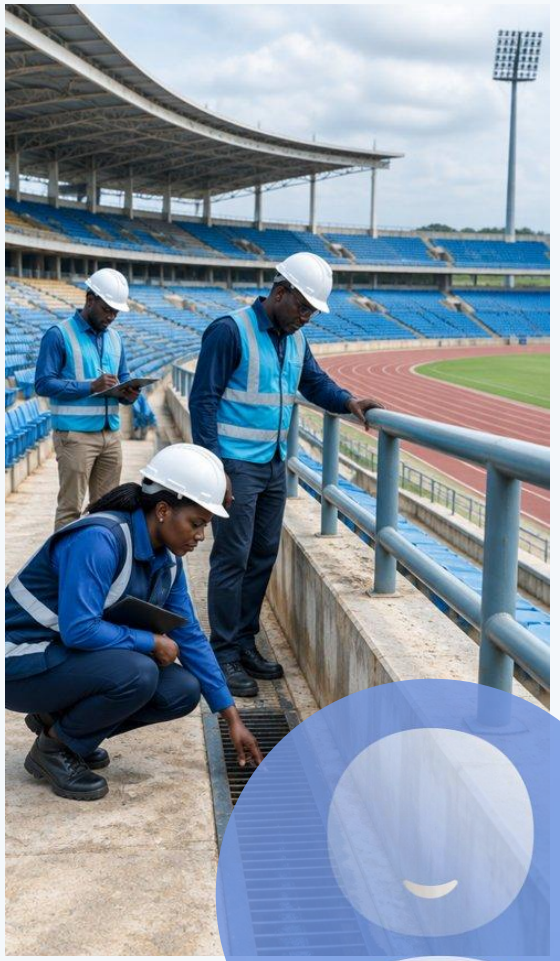
Short-term event management
Events lack a coordinated, lifecycle strategy

Akinsola et al. (2012); Awoyinfa et al. (2017); Ogunsanya & Efoobi (2022)

Engineering advances elsewhere

- Modular stands and retractable roofs
- Energy-efficient lighting and solar panels
- Rainwater-harvesting systems
- Building information modelling (BIM)
- Smart turnstiles and digital ticketing
- Automated maintenance systems

Benchmarks: London 2012 Olympic Park and the Qatar 2022 stadiums



Research Problem and Gap

The problem

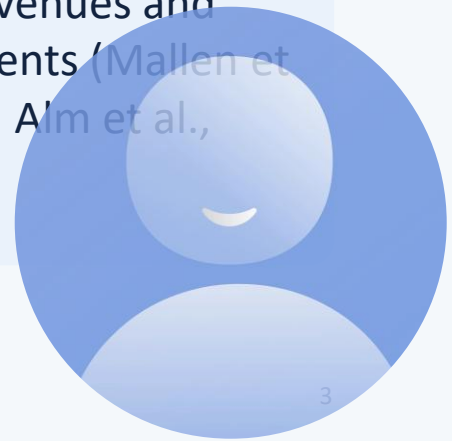
- Many public venues are underused and poorly maintained
- They begin to break down shortly after opening
- Maintenance is reactive, not planned

1 Dispersed studies
Single-state or single-institution work; no review across all six zones

2 Narrow focus
Availability, upkeep and funding dominate; energy, modular design, drainage, and digital systems are not often examined

3 Weak event link
Few studies link facility condition to event performance; none use engineering assessment

4 Mega-event bias
Legacy research centres on large venues and major events (Mallen et al., 2010; Alm et al., 2016)



Aim and Research Questions

Aim: to examine how engineering innovations affect infrastructure sustainability and event management across Nigeria's six geopolitical zones, benchmarked against global best practice.

RQ1

What problems affect facility condition, adequacy, and maintenance in each region?

RQ2

Which design, construction, energy, maintenance and digital innovations are present or missing?

RQ3

How do conditions and innovations affect event planning, safety, spectator experience, and revenue?

RQ4

How does Nigeria compare with global best practices, and what can be adopted or adapted from them?

RQ5

What engineering and policy priorities suit each region?



Lessons from Global Benchmarks

~156%

average real-terms cost overrun of the Olympic Games (Flyvbjerg et al., 2016)

Post-event venue costs must be planned for

London 2012

Sustainability is required from the start; temporary venues and venues designed for reuse (LOCOG, 2012; Gratton & Preuss, 2008)

Qatar 2022

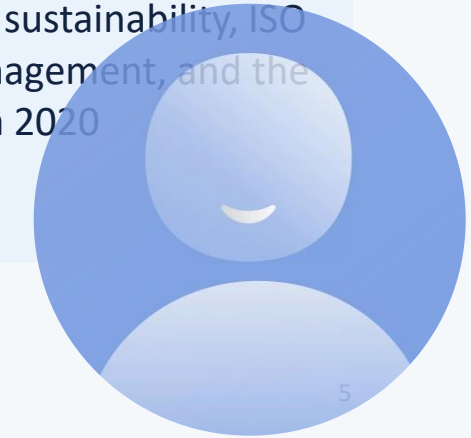
Stadium 974 designed to be dismantled and shipped; net capacity 40,000; functional areas in certified containers (Stockhusen et al., 2024)

Flexible design

Retractable pitch (Tottenham Hotspur Stadium) and retractable roof (Singapore National Stadium) let one venue host varied events

Standards

ISO 20121 for event sustainability, ISO 55001 for asset management, and the IOC Olympic Agenda 2020



Maintenance, Technology and Local Conditions

Maintenance

Preventive versus corrective work; align maintenance with objectives (Horner et al., 1997). Nigerian public buildings: weak funding, no planned programmes, untrained staff (Ebekozien et al., 2022)

Technology adoption

Tools work only if used: usefulness, ease of use, social influence, and facilitating conditions decide adoption (Venkatesh et al., 2016; Dearing & Cox, 2018)

Power

Reliance on backup generators; renewables plus efficiency needed (Oyedepo, 2012); solar-battery-generator hybrids assessed (Ijeoma et al., 2024)

Flooding

Lagos flood control rests on building and maintaining drains (Adelekan, 2016); clearing drains is the main action (Akoteyon, 2022)



For sports venues, drainage and power supply are the primary engineering maintenance problems

Conceptual Framework

Geopolitical zone
local conditions moderate the strength of each link

Engineering innovations
energy, modular design, water, digital systems, maintenance

Facility sustainability
condition, durability, lifecycle cost, resilience

Event management performance
safety, delivery, revenue, spectator experience

Global benchmarks and standards
ISO 20121, ISO 55001, FIFA, IOC

Rooted in facility life-cycle management and the ISO 20121 event sustainability model



Research Methodology

1

Design

- Qualitative narrative review, grouped by zone
- PRISMA 2020 (Page et al., 2021)
- Narrative synthesis: methods and quality varied

2

Search

- Google Scholar, AJOL, ResearchGate, Scopus, Web of Science, Nigerian repositories
- Target: 2-3 studies per zone (12-18)

3

Inclusion

- Empirical, Nigerian, government-associated site
- Peer-reviewed article or accessible thesis, full text verifiable
- Opinion-only or unverifiable texts excluded

4

Appraisal

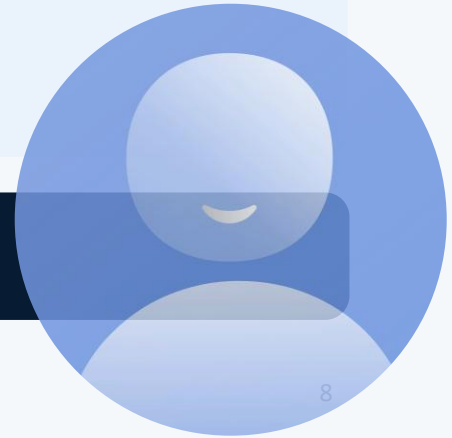
- CASP for qualitative studies
- MMAT for quantitative and mixed methods
- Weighted by appraisal score and relevance

5

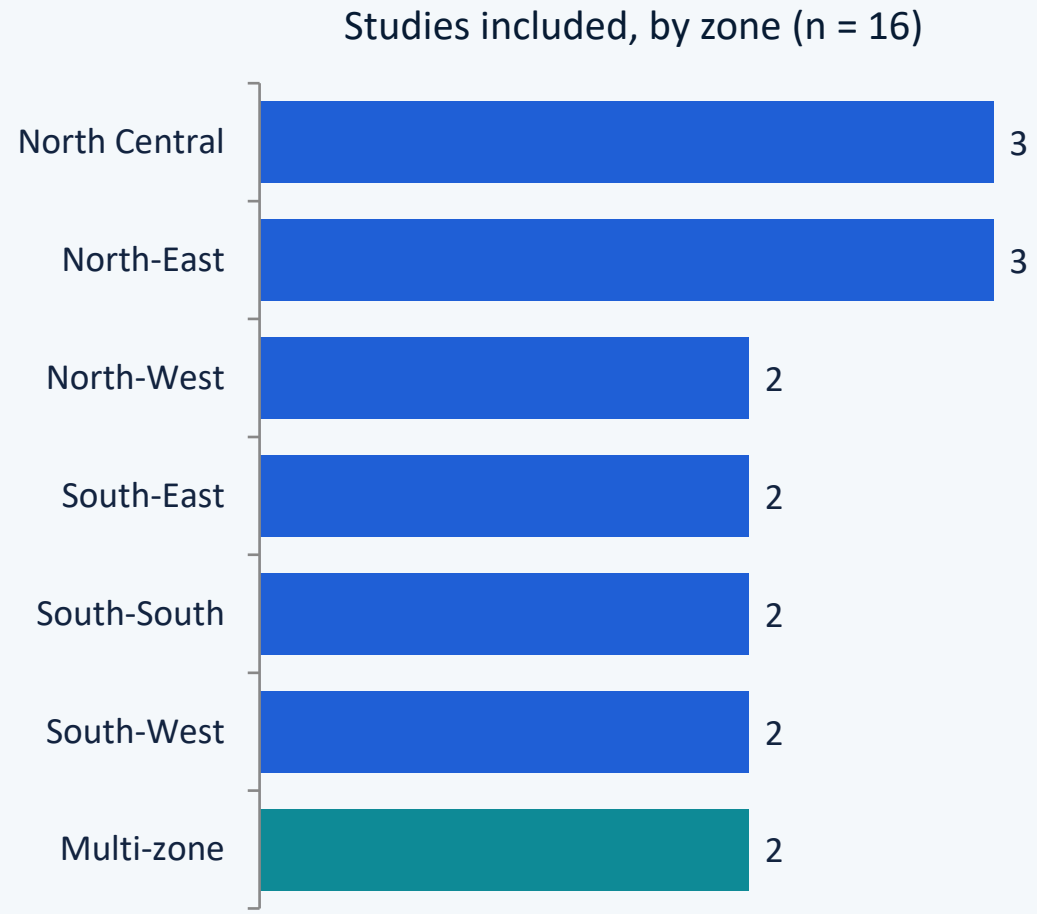
Synthesis

- Thematic synthesis (Thomas & Harden, 2008)
- Rereading and recoding when unclear (Braun & Clarke, 2021)

Global benchmark material was analysed separately from the zone-specific sample



Evidence Base: 16 Studies Across Six Zones



Key studies

Ogunsanya & Efoobi (2022): Moshood Abiola Stadium, Abuja; cost of poor maintenance

Joel & Abdulraheem (2019): 994 athletes at the 2018 National Youth Games

Ekuri (2018): facility standards and Cross River performance at the National Sports Festival

Sani et al. (2022): the only direct study of technology adoption

Multi-zone = two studies covering more than one zone (Sani et al., 2022; Awoyinfa et al., 2017)

Cross-Zone Findings

Maintenance and funding

No maintenance budget, unclear responsibilities, and repairs only after failure (Akinsola et al., 2012)

Provision and standards

Studies count facilities and check standards; design quality and engineering standards remain poorly understood

Technology and design

Only Sani et al. (2022) and Hussaini (1999) address them; most authors come from physical education and sports administration

Events and revenue

Standards tied to National Sports Festival results; poor upkeep raises costs and weakens sponsorship and commercialisation (Awoyinfa et al., 2017)

Nigeria Compared with Global Practice

Area	Global practice	Nigerian evidence so far	Transferability
Maintenance management	Planned maintenance; ISO 55001	Reactive upkeep; funding and responsibility gaps	High: organisational and budgetary
Modular and convertible design	Stadium 974; London 2012 overlays; retractable roofs	Not examined directly in the screened studies	Medium: suited to event overlays
Energy and water	Solar, efficient floodlighting, rainwater harvesting	Not evident in titles and abstracts screened	Medium to high: local audits first
Digital operations	BIM, smart turnstiles, digital ticketing	One technology-adoption study (Sani et al., 2022)	Varies with individual skills
Event sustainability	ISO 20121; FIFA and IOC frameworks	Links limited to a sports festival and a youth games	Medium: major events first

The main problem is organisation, not technology. Reactive repair contrasts with the strategy Horner et al. (1997) recommend; funding concerns echo Mallen et al. (2010).

Provisional Priorities by Zone

North Central

Preventive maintenance schedules, lifecycle cost analysis, and event-readiness assessments

North-East

Maintenance budget allocations, planning-led design for new facilities, revised condition survey

North-West

Pre-construction condition assessment and rehabilitation plan

South-East

Gather evidence first: repository search and a brief engineering audit

South-South

Event-readiness standards for festival venues; local enforcement of provision requirements

South-West

Performance-based maintenance contracts; pilots for digital maintenance records and energy metering

Provisional: recommendations for testing, not conclusions. In every zone: audit first, then fund scheduled maintenance, then fund modular and digital systems where audits show a need.

Implications and Contribution to Knowledge

Theory

A zone-moderated framework linking engineering innovation, facility sustainability and event performance

Policy

Dedicated maintenance funding; engineering audits within education-sector facility surveys

Practice

Lifecycle planning before advanced technology; targeted training for digital tools (Sani et al., 2022)

Originality

To the authors' knowledge, the first review across all six zones set against international practice

Contribution: a zone-by-zone comparison with international practice that addresses fragmented studies, limited engineering focus, and few cross-zone comparisons

Limitations





Surveys, not audits

Most Nigerian studies assess perceptions and availability rather than technical condition



Hard-to-access sources

Many are unpublished theses, and a few are outdated, which limits verification



Uneven zone coverage

Data vary by zone and are especially scarce for the South-East



Work still underway

Full-text extraction and quality appraisal are ongoing; summaries include only verified results

The framework and priorities are intended to guide future empirical testing

Recommendations

1. Secure dedicated funding for maintenance
2. Complete lifecycle planning before introducing new technology
3. Run condition audits and set planned maintenance programmes in every zone
4. Include engineering audits in education-sector facility surveys
5. Future research: full-text extraction and quality appraisal, South-East repository search, and audits of a representative sample of venues per zone to test the framework

Conclusion

1. Across 16 studies in six zones, the main problems are maintenance, funding, facility supply, and adherence to standards, not technology

2. Engineering innovation is rarely examined directly; only one study addresses technology adoption

3. London 2012 and Qatar 2022 planned venues for their whole lifecycle; Nigerian maintenance is largely reactive

1 Audit

2 Fund scheduled maintenance

3 Then modernise: modular and digital systems where audits show need

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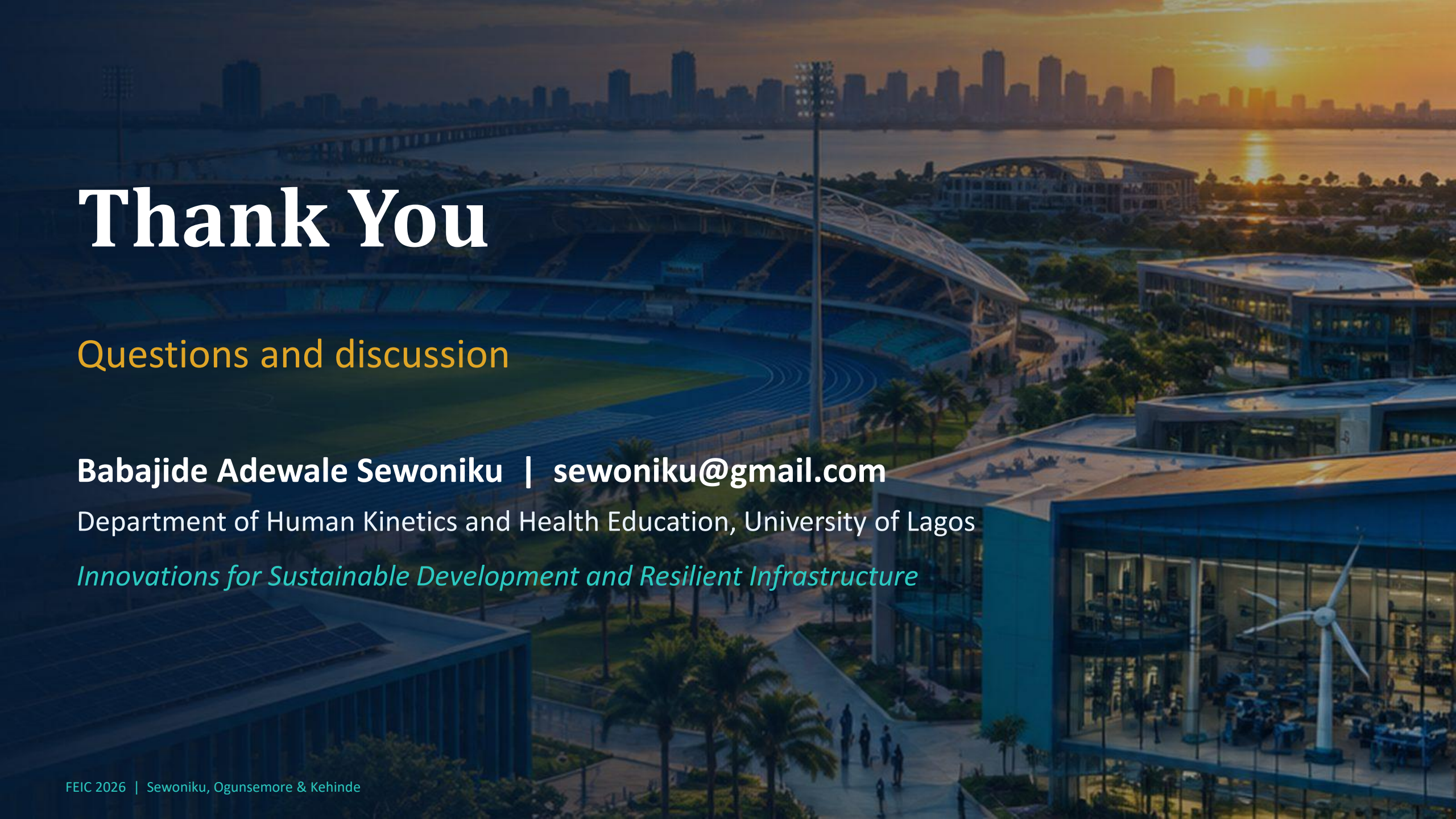
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Selected sources shown. The full list of 61 references is in the paper; other works cited on the slides (e.g., Ebekozien et al., 2022; Oyedepo, 2012) are listed there.



Thank You

Questions and discussion

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