

Optimizing Circulation and Wayfinding Using Space-Syntax Principles in the Proposed International Conference Centre, Aluu, Rivers State.

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ABSTRACT

Efficient circulation and intuitive wayfinding are critical to the functionality, accessibility, and user experience of contemporary international conference centres. However, many conference facilities continue to experience fragmented circulation networks, weak spatial hierarchy, poor connectivity, congestion, and inadequate environmental legibility, resulting in reduced operational efficiency and user satisfaction. Although Space Syntax has been widely applied to evaluate movement patterns in hospitals, airports, museums, educational institutions, and commercial buildings, its application to conference centre planning remains limited. Likewise, biophilic design has primarily been examined from environmental and well-being perspectives, with little emphasis on its role in circulation planning and spatial orientation.

This study investigates how Space Syntax principles can be integrated with biophilic design strategies to optimise circulation efficiency and wayfinding in the proposed International Conference Centre, Aluu, Rivers State, Nigeria. A qualitative multiple case study approach was adopted, involving a comparative analysis of five established conference centres using documentary evidence, architectural drawings, photographs, and published literature. The analysis focused on key Space Syntax variables, including connectivity, integration, and intelligibility, alongside biophilic attributes such as natural lighting, landscape integration, visual openness, and environmental landmarks.

The findings indicate that conference centres with highly integrated spatial layouts, strong connectivity, and clear circulation hierarchies consistently achieve better movement efficiency, reduced congestion, improved accessibility, and enhanced wayfinding. The study further demonstrates that integrating biophilic elements into circulation systems strengthens users' cognitive mapping, environmental legibility, and overall spatial experience. Based on these findings, the study proposes the Ecological Conference Boulevard (ECB) as an integrated architectural framework that combines Space Syntax principles with biophilic design to improve circulation efficiency, environmental quality, spatial intelligibility, and user experience. The framework provides architects, planners, and policymakers with an evidence-based approach for designing sustainable, legible, and user-centred conference facilities.

Keywords: Space Syntax, Biophilic Design, Circulation Efficiency, Wayfinding, International Conference Centre, Spatial Integration, Ecological Conference Boulevard.

INTRODUCTION

Background of the Study

Globalisation, business tourism, international diplomacy, and knowledge exchange have increased the demand for conference centres that are functionally efficient, environmentally responsive, and capable of supporting diverse activities. Contemporary conference centres are no longer limited to hosting meetings; they accommodate conventions, exhibitions, trade fairs, diplomatic summits, corporate events, and cultural

programmes. Consequently, their success depends not only on the provision of adequate spaces but also on effective circulation systems that enhance accessibility, operational efficiency, and user satisfaction (International Congress and Convention Association [ICCA], 2024).

Circulation represents the network of movement spaces including entrances, lobbies, corridors, atria, staircases, ramps, and elevators that connect functional areas within a building. Well-planned circulation reduces travel distance, minimises congestion, improves accessibility, and supports efficient building operations, whereas poorly organised circulation often results in user disorientation, pedestrian conflicts, and reduced building performance (Akubue, 2022; Erema, 2026).

Closely related to circulation is wayfinding, the cognitive process through which users interpret spatial information to navigate unfamiliar environments (Arthur & Passini, 1992). Contemporary research shows that effective wayfinding depends more on spatial organisation, visual connectivity, spatial hierarchy, and environmental legibility than on signage alone (Lee et al., 2023).

Space Syntax Theory, developed by Hillier and Hanson (1984), provides an evidence-based framework for analysing how spatial configuration influences movement, accessibility, and social interaction. Through indicators such as connectivity, integration, and intelligibility, the theory enables architects to evaluate circulation performance objectively during the design stage. Although widely applied in healthcare, educational, commercial, and transportation facilities, its application within conference centre architecture remains limited.

At the same time, biophilic design has gained recognition for improving environmental quality, cognitive performance, and user well-being by incorporating natural light, vegetation, landscape views, water features, and natural materials (Kellert et al., 2011). However, these environmental strategies have rarely been integrated with circulation planning to improve navigation and spatial orientation.

This study addresses these gaps by integrating Space Syntax principles with biophilic design strategies to develop the Ecological Conference Boulevard (ECB) an evidence based framework that reconceptualises circulation as an environmental, social, and spatial system capable of enhancing movement efficiency, intuitive wayfinding, environmental quality, and user experience within the proposed International Conference Centre, Aluu, Rivers State.

Statement of the Problem

The increasing complexity of contemporary conference centres has intensified the demand for circulation systems that support efficient movement, intuitive navigation, and seamless interaction among diverse users. Despite advances in architectural design and building technology, many conference centres continue to experience fragmented circulation networks, poor spatial integration, weak circulation hierarchy, congestion, and ineffective wayfinding. These deficiencies reduce operational efficiency, increase travel distances, and negatively affect visitors' experiences (Akubue, 2022; Erema, 2026).

Existing research generally considers Space Syntax and biophilic design as separate design approaches. Consequently, there is no comprehensive framework that integrates configurational analysis with environmental design to improve circulation efficiency, spatial intelligibility, environmental quality, and user experience in conference centres. This study addresses this gap by developing the Ecological Conference Boulevard (ECB) as an integrated framework for conference centre planning.

Research Gap

Existing literature demonstrates the effectiveness of Space Syntax in evaluating spatial configuration and the benefits of biophilic design in improving environmental quality. However, few studies have integrated these approaches into a unified framework for conference-centre architecture. Conference centres remain underrepresented in Space Syntax research despite their complex circulation requirements, and limited attention has been given to the role of ecological design in supporting movement, cognitive mapping, and wayfinding.

This study bridges these theoretical and practical gaps by integrating Space Syntax principles with biophilic design strategies through the proposed Ecological Conference Boulevard (ECB), providing an evidence-based framework for improving circulation efficiency and wayfinding in conference centre architecture.

Aim of the Study

The aim of this study is to investigate how Space Syntax principles and biophilic design strategies can be integrated to optimise circulation efficiency and wayfinding in the proposed International Conference Centre, Aluu, Rivers State.

Objectives of the Study

The study seeks to:

Evaluate the influence of Space Syntax and biophilic design principles on circulation efficiency and wayfinding through a comparative analysis of selected international conference centres.

Develop the Ecological Conference Boulevard (ECB) as an integrated architectural framework for improving circulation efficiency, spatial intelligibility, and user experience in the proposed International Conference Centre, Aluu, Rivers State.

Research Questions

The study addresses the following questions:

How do Space Syntax and biophilic design principles influence circulation efficiency and wayfinding in international conference centres?

How can the Ecological Conference Boulevard (ECB) improve circulation efficiency, spatial intelligibility, and user experience in the proposed International Conference Centre, Aluu, Rivers State?

Significance of the Study

This study contributes to conference-centre architecture by demonstrating how Space Syntax principles and biophilic design strategies can be integrated to improve circulation efficiency and wayfinding. It extends the application of Space Syntax beyond conventional configurational analysis by incorporating environmental design into circulation planning.

Practically, the study provides architects, planners, developers, and policymakers with evidence-based strategies for designing conference centres that are more accessible, environmentally responsive, and user-centred. The proposed Ecological Conference Boulevard (ECB) offers a transferable framework for improving movement efficiency, spatial legibility, environmental quality, and user experience in conference centres and other complex public buildings.

LITERATURE REVIEW

Overview

Efficient circulation and intuitive wayfinding are fundamental to the functional performance of contemporary international conference centres. As these facilities accommodate multiple events, large visitor populations, and diverse user groups simultaneously, their spatial organisation must support efficient movement, accessibility, environmental comfort, and user satisfaction. Existing literature identifies Space Syntax as a reliable analytical framework for evaluating spatial configuration and predicting movement behaviour, while biophilic design has been recognised for enhancing environmental quality and occupants' psychological well-being. However, these

research domains have largely developed independently, leaving limited evidence on how they can be integrated within conference centre architecture. This review synthesises current knowledge, identifies theoretical and empirical gaps, and establishes the basis for the proposed Ecological Conference Boulevard (ECB) framework.

Conference Centre Architecture

International conference centres have evolved into multifunctional facilities that accommodate conferences, exhibitions, diplomatic meetings, business forums, and cultural events. Their performance depends not only on functional space allocation but also on accessibility, circulation efficiency, flexibility, and user experience (ICCA, 2024).

Earlier planning approaches focused primarily on functional zoning, treating circulation as a secondary element linking activity spaces. While adequate for basic operations, such approaches frequently produced fragmented layouts, long corridors, poor visual connectivity, and inadequate orientation. Contemporary architectural research instead regards circulation as an organising principle that influences movement behaviour, accessibility, operational efficiency, and users' spatial perception (Lee et al., 2023; Mohamed & van der Laag-Yamu, 2024).

Despite advances in sustainable and technologically advanced conference-centre design, relatively few studies have examined how spatial configuration influences circulation performance. Environmental interventions such as landscaping, daylighting, and green infrastructure are also commonly treated as independent sustainability measures rather than integral components of movement and orientation systems. This limitation highlights the need for integrated planning approaches that combine configurational efficiency with environmental experience.

Circulation Efficiency and Wayfinding

Circulation refers to the organised network of spaces that facilitates movement between functional areas. In conference centres, circulation systems influence accessibility, travel distance, operational efficiency, emergency evacuation, and user satisfaction (Ching, 2023).

Efficient circulation is characterised by logical spatial relationships, clear movement hierarchy, direct access routes, and minimal congestion. Conversely, fragmented circulation networks increase travel distances, create bottlenecks, reduce accessibility, and impair building performance (Ereama, 2026).

Wayfinding complements circulation by describing how users perceive, interpret, and navigate unfamiliar environments (Arthur & Passini, 1992). Although signage contributes to navigation, research consistently demonstrates that architectural configuration, visual connectivity, spatial hierarchy, and recognisable landmarks play a greater role in enabling intuitive orientation (Passini, 1996; Lee et al., 2023). Buildings with highly legible layouts generally require less dependence on signage because the architecture itself communicates spatial organisation.

For conference centres, where visitors often have limited familiarity with the environment and must move efficiently between multiple destinations, circulation and wayfinding should be considered as integrated design objectives rather than separate architectural components.

Space Syntax Theory

Space Syntax Theory, introduced by Hillier and Hanson (1984), explains how spatial configuration influences movement patterns, accessibility, and social interaction. Rather than relying solely on designers' intuition, the theory provides objective measures including connectivity, integration, intelligibility, choice, and depth to evaluate circulation performance during the design stage.

Space Syntax has been successfully applied in hospitals, airports, educational institutions, museums, commercial developments, and urban environments. However, its application within conference centre architecture remains limited despite the complexity of movement patterns associated with conferences, exhibitions, and large public

gatherings. Furthermore, most Space Syntax studies focus primarily on configurational relationships while giving comparatively little attention to environmental quality, sensory experience, and ecological design.

Biophilic Design

Biophilic Design Theory originates from Wilson's (1984) Biophilia Hypothesis and was later developed into an architectural framework by Kellert et al. (2011). The theory proposes that integrating natural systems into the built environment improves physical health, psychological well-being, cognitive performance, and environmental satisfaction.

Biophilic design incorporates elements such as natural lighting, vegetation, water features, landscape views, natural materials, and ecological processes to create healthier and more engaging environments. Research consistently demonstrates that exposure to these elements reduces stress, enhances concentration, improves spatial memory, and strengthens users' environmental perception (Kellert et al., 2011).

Despite these benefits, most architectural applications emphasise environmental sustainability and occupant well-being, with limited attention to how biophilic elements can improve circulation efficiency and wayfinding. Ecological features possess significant potential to function as visual landmarks, orientation devices, and spatial organisers, particularly in large and unfamiliar public buildings such as conference centres.

THEORETICAL AND CONCEPTUAL FRAMEWORK

The study is grounded in Space Syntax Theory and supported by Biophilic Design Theory. Space Syntax explains how spatial configuration influences accessibility, movement behaviour, and spatial cognition, whereas Biophilic Design explains how environmental qualities influence perception, psychological comfort, and cognitive performance.

Neither theory independently provides a comprehensive explanation for circulation efficiency in conference centres. Space Syntax offers objective analytical tools but gives limited consideration to environmental experience. Conversely, Biophilic Design enhances environmental quality without providing measurable methods for evaluating spatial configuration.

The integration of these theories forms the conceptual basis of the Ecological Conference Boulevard (ECB). Within this framework, circulation is reconceptualised as an environmental and social infrastructure where spatial integration is reinforced by natural lighting, vegetation, landscape corridors, environmental landmarks, and visual openness. The framework proposes that combining configurational efficiency with environmental design improves movement efficiency, spatial intelligibility, environmental comfort, and user experience simultaneously.

Empirical Review

Empirical studies consistently demonstrate that spatial configuration significantly influences circulation efficiency and users' movement behaviour. Hillier (1996) established that highly integrated spaces attract greater pedestrian movement than segregated layouts. Subsequent investigations by Lee et al. (2023) and Mohamed and van der Laag-Yamu (2024) confirmed that configurational analysis improves accessibility, movement efficiency, and design decision-making.

Wayfinding research similarly indicates that intuitive navigation depends primarily on architectural organisation rather than signage systems (Arthur & Passini, 1992; Passini, 1996). Buildings characterised by clear hierarchy, visual connectivity, and recognisable landmarks consistently support more efficient navigation.

Empirical evidence also confirms that biophilic environments improve cognitive performance, reduce stress, and enhance users' environmental perception (Kellert et al., 2011). However, these studies have focused predominantly on health and environmental quality rather than movement behaviour.

A critical comparison of previous studies reveals three important limitations:

Most studies investigate Space Syntax and biophilic design independently rather than integrating both approaches.

Conference centre architecture remains significantly underrepresented within Space Syntax research.

Existing studies primarily evaluate completed buildings without proposing transferable architectural frameworks for future conference centre design.

These limitations justify the development of the Ecological Conference Boulevard (ECB) as an integrated framework combining configurational analysis with ecological design to improve circulation efficiency, wayfinding, environmental quality, and user experience.

Literature Synthesis

The reviewed literature demonstrates broad agreement that circulation efficiency and intuitive wayfinding are fundamental determinants of conference centre performance. Space Syntax provides an objective method for evaluating spatial configuration, while biophilic design contributes significantly to environmental quality and human well-being. Nevertheless, existing research has largely treated these concepts independently.

This study addresses these gaps by proposing the Ecological Conference Boulevard (ECB) as an evidence-based framework that integrates Space Syntax principles with biophilic design strategies. Unlike previous approaches, the ECB treats circulation as a multifunctional architectural system that simultaneously supports movement efficiency, intuitive wayfinding, environmental sustainability, social interaction, and spatial identity. Consequently, the study extends current architectural knowledge and provides a practical planning model for future conference centre development.

METHODOLOGY

Research Design

This study adopted a qualitative multiple case study design to investigate how Space Syntax principles and biophilic design strategies can be integrated to improve circulation efficiency and wayfinding in the proposed International Conference Centre, Aluu, Rivers State, Nigeria. A qualitative approach was considered appropriate because the study sought to interpret architectural configurations, circulation systems, and environmental characteristics within their real world contexts rather than establish statistical relationships (Creswell & Poth, 2018).

The multiple case study strategy enabled a systematic comparison of selected conference centres, facilitating the identification of recurring design principles, contextual variations, and transferable best practices. This approach strengthens analytical generalisation and enhances the credibility of architectural recommendations (Yin, 2018).

The research was further guided by the principles of Evidence Based Design (EBD), which advocate that architectural decisions should be informed by empirical evidence, theoretical knowledge, and precedent analysis rather than intuition alone (Hamilton & Watkins, 2009). Accordingly, the study synthesised insights from Space Syntax Theory, Biophilic Design Theory, and comparative case studies to develop the proposed Ecological Conference Boulevard (ECB) framework.

Research Philosophy and Approach

The study adopted an interpretivist research philosophy, recognising that architectural quality and spatial experience are shaped by users' interactions with the built environment. This perspective enabled the

investigation of circulation, accessibility, environmental quality, and wayfinding as interconnected aspects of architectural performance.

An evidence based comparative architectural approach was employed through documentary analysis of selected conference centres. Rather than describing individual buildings in isolation, the study critically compared spatial organisation, circulation hierarchy, accessibility, environmental integration, and wayfinding systems to identify planning strategies applicable to the proposed International Conference Centre in Aluu.

Data Sources

The study relied exclusively on secondary data obtained from credible academic and professional sources. These included peer-reviewed journal articles, scholarly books, conference proceedings, architectural reports, project manuals, official publications, floor plans, sections, photographs, and institutional websites.

The use of multiple documentary sources enabled data triangulation and strengthened the credibility of the findings. Contemporary literature on Space Syntax, biophilic design, environmental psychology, and conference-centre planning provided the theoretical foundation for interpreting the case-study evidence and developing the proposed architectural framework.

Case Study Selection

A purposive sampling technique was used to select information-rich conference centres that best addressed the objectives of the study (Creswell & Poth, 2018). Five conference centres representing different geographical contexts and planning approaches were selected:

Calabar International Convention Centre (Nigeria)

Abuja International Conference Centre (Nigeria)

United Nations Conference Centre, Addis Ababa (Ethiopia)

Century City Conference Centre, Cape Town (South Africa)

International Conference Centre Geneva (Switzerland)

The combination of Nigerian and international precedents enabled comparison between local practice and global best practices while identifying design principles transferable to the proposed conference centre in Aluu.

Criteria for Case Study Selection

The selected conference centres satisfied the following criteria:

Purpose built facilities for international conferences and large public events.

Clearly defined circulation systems suitable for Space Syntax evaluation.

Availability of reliable architectural documentation.

Demonstrated architectural significance, functional efficiency, and environmental responsiveness.

Representation of diverse geographical and socio-cultural contexts.

Relevance to the planning objectives of the proposed International Conference Centre, Aluu.

These criteria ensured methodological consistency and enhanced the validity of the comparative analysis.

Data Collection

Data were collected through documentary analysis, involving a systematic review of architectural drawings, floor plans, site plans, photographs, project reports, journal publications, and official documentation. The documentary evidence was supplemented with literature on Space Syntax, biophilic design, circulation planning, environmental psychology, and sustainable architecture.

This approach enabled a comprehensive evaluation of circulation networks, spatial hierarchy, accessibility, wayfinding systems, environmental integration, and functional zoning across the selected case studies.

Data Analysis

Data were analysed using a comparative architectural analysis informed by Space Syntax principles and biophilic design criteria.

The analysis focused on:

Spatial connectivity

Integration

Intelligibility

Accessibility

Circulation hierarchy

Wayfinding performance

Environmental quality

Natural lighting

Landscape integration

Visual openness

Environmental landmarks

Cross case synthesis was employed to identify common design strategies, recurring deficiencies, and transferable planning principles. The findings informed the development of the Ecological Conference Boulevard (ECB) as an integrated framework for improving circulation efficiency and wayfinding in conference centre architecture.

Comparative Case Studies

Overview

Five conference centres were comparatively analysed to identify architectural strategies that enhance circulation efficiency, spatial legibility, wayfinding, and environmental quality. The analysis focused on spatial configuration, circulation hierarchy, accessibility, environmental integration, and user experience using Space Syntax and biophilic design principles. The findings informed the development of the proposed Ecological Conference Boulevard (ECB) framework.

Calabar International Convention Centre (CICC), Nigeria

The Calabar International Convention Centre is one of Nigeria's major event facilities, designed to accommodate conferences, exhibitions, and public gatherings. The building demonstrates a clear functional zoning system that separates public, administrative, and service areas, thereby reducing operational conflicts.

Its circulation system is organised around a central entrance lobby that distributes visitors efficiently to major functional spaces. Wide corridors and strategically positioned vertical circulation elements improve accessibility and pedestrian flow during large events. However, the facility relies heavily on signage for orientation, while environmental features play a limited role in supporting intuitive wayfinding.

Although landscaped open spaces contribute to the visual quality of the environment, their integration into the circulation network remains relatively weak.

Key Lessons

Clear functional zoning improves operational efficiency.

Centralised circulation nodes enhance accessibility.

Greater integration of landscape features could strengthen wayfinding and environmental quality.



Fig. 4.7: Ground Floor Plan of CICC

Source: CICC (2014)



Fig. 4.8: First Floor plan of CICC

Fig 4.1: Picture of floor Floor Plan of Calabar International Convention Centre.

Source: (crspppprojects.org.ng 2026).



Fig 4.2: Picture of Exterior View of Calabar International Convention Centre.

Source: (crspppprojects.org.ng 2026).

Abuja International Conference Centre (AICC), Nigeria

The Abuja International Conference Centre is one of the country's most important diplomatic and conference venues. Its spatial organisation reflects a hierarchical planning approach in which major conference halls, meeting rooms, exhibition areas, and administrative spaces are connected through a central circulation spine.

The building provides efficient access to principal facilities but exhibits long internal corridors that reduce visual connectivity and create dependence on directional signage. While circulation is functionally organised, limited daylight penetration and insufficient environmental landmarks reduce spatial legibility.

The study indicates that integrating natural lighting, landscape elements, and visual focal points could significantly improve users' orientation and movement experience.

Key Lessons

Strong circulation hierarchy supports efficient movement.

Excessive corridor length reduces intuitive navigation.

Environmental design should complement spatial configuration.

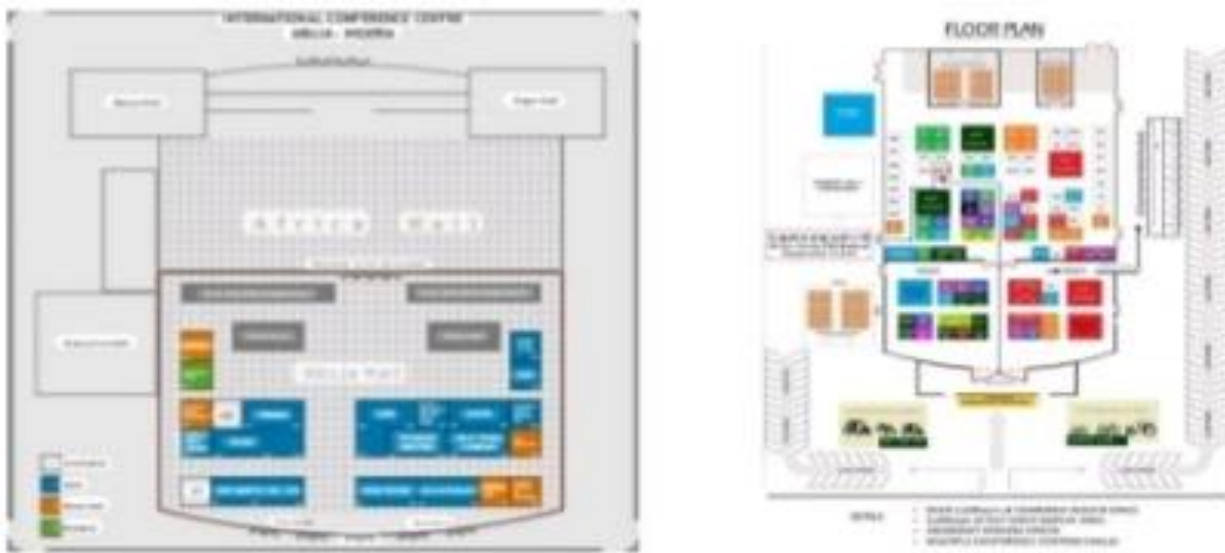


Fig 4.3: Picture of Floor Plan of Abuja International Conference Centre.

Source: (fcta.gov.ng 2026).



Fig 4.4: Picture of Approach view of Abuja International Conference Centre.

Source: (fcta.gov.ng 2026).

United Nations Conference Centre (UNCC), Addis Ababa, Ethiopia

The United Nations Conference Centre demonstrates an integrated planning strategy characterised by high spatial connectivity, logical circulation patterns, and effective separation of public, diplomatic, administrative, and service functions.

Its circulation network minimises pedestrian conflicts while maintaining efficient access between major activity areas. The building benefits from generous natural lighting, landscaped outdoor spaces, and visual openness, all of which enhance users' spatial orientation and environmental comfort.

The integration of environmental features with circulation routes illustrates how ecological design can strengthen cognitive mapping and improve overall user experience.

Key Lessons

Integrated circulation networks improve movement efficiency.

Visual openness enhances spatial legibility.

Landscape elements effectively support intuitive wayfinding.

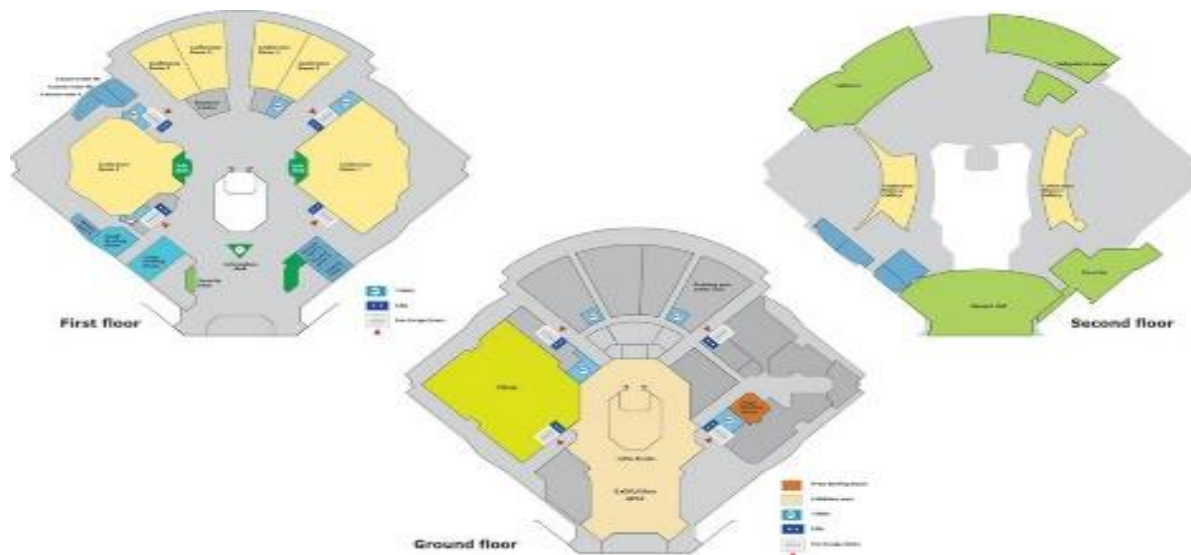


Fig 4.5: Picture of Floor Plans of The United Nation conference centre Addis Ababa, Ethiopia.

Source: (uneca.org 2026)



Fig 4.6: Picture of the Entrance of United Nation conference centre Addis Ababa, Ethiopia.

Source: (uneca.org 2026).

Century City Conference Centre (CCCC), Cape Town, South Africa

Century City Conference Centre adopts a flexible planning concept that accommodates conferences of varying scales while maintaining efficient circulation throughout the facility.

The circulation system is characterised by interconnected public spaces, multiple access routes, and clearly defined movement corridors. Large glazed openings maximise daylight penetration, strengthen visual connections, and improve environmental quality.

Outdoor terraces and landscaped public areas function as extensions of internal circulation spaces, providing opportunities for informal interaction while reinforcing orientation within the complex.

Key Lessons

Flexible circulation accommodates diverse event requirements.

Daylighting enhances spatial perception.

Outdoor spaces improve environmental quality and user experience.



Fig 4.7: Picture of the Floor Plan of The Century Centre Cape Town, South Africa

Source: (ccconferencecentre.co.za 2026)



Fig 4.8: Picture of the Entrance of The Century Centre Cape Town, South Africa

Source: (ccconferencecentre.co.za 2026).

International Conference Centre Geneva (CICG), Switzerland

The International Conference Centre Geneva represents an advanced example of conference centre planning, combining efficient circulation with high environmental performance.

The building exhibits excellent spatial integration, allowing visitors to navigate efficiently between conference halls, meeting rooms, exhibition spaces, and support facilities. Multiple visual connections, transparent public spaces, and clearly defined circulation nodes contribute to intuitive wayfinding.

Sustainable design features, including extensive natural lighting, landscaped surroundings, and environmentally responsive building systems, reinforce both operational efficiency and occupant comfort.

Key Lessons

High spatial integration improves circulation efficiency.

Transparent public spaces strengthen wayfinding.

Sustainable environmental strategies enhance overall building performance.

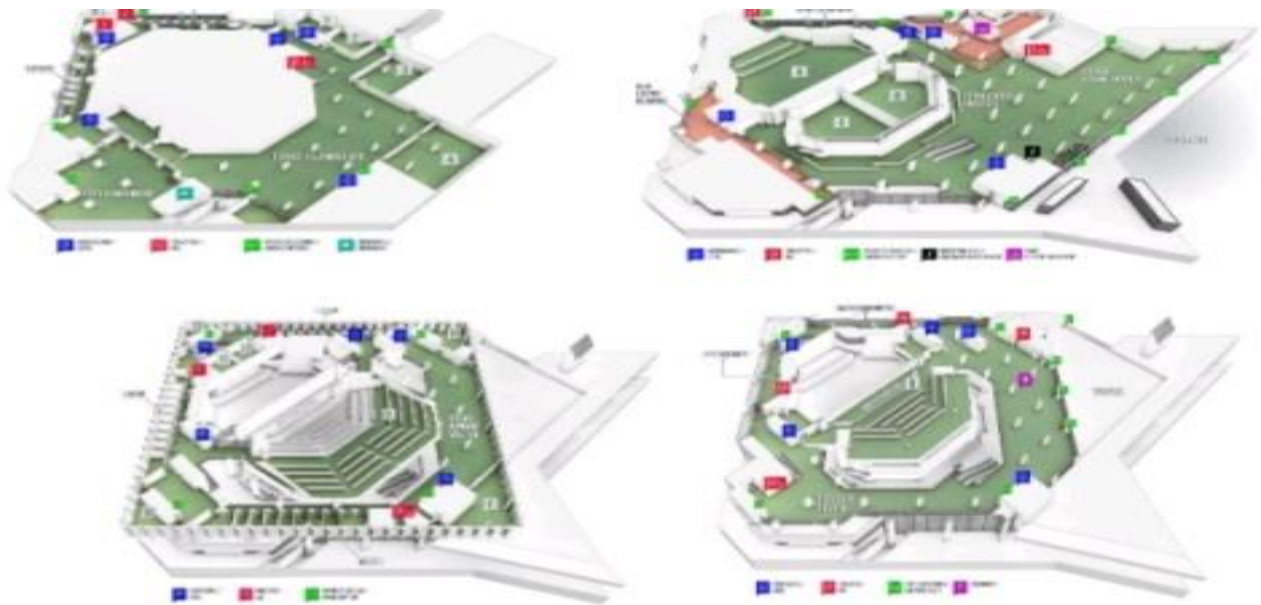


Fig 4.9: Picture of the Floor Plans of International Conference Centre Geneva

Source: (cicg.ch 2026)



Fig 4.10: Picture of the Entrance of International Conference Centre Geneva

Source: (cicg.ch 2026)

Cross Case Comparative Analysis

Comparative evaluation of the five conference centres revealed several recurring design principles.

Spatial Configuration

Buildings with highly integrated layouts consistently demonstrated:

Shorter travel distances.

Better accessibility.

Reduced pedestrian congestion.

Improved movement efficiency.

Facilities characterised by fragmented layouts required greater reliance on signage and experienced more frequent circulation conflicts.

Circulation Hierarchy

Successful conference centres established clear movement hierarchies through:

Central circulation spines.

Well-defined entrance lobbies.

Strategic placement of vertical circulation.

Logical functional zoning.

These characteristics improved operational efficiency while simplifying navigation.

Wayfinding

The study confirmed that intuitive navigation depends primarily on architectural organisation rather than signage.

Effective wayfinding was associated with:

Visual connectivity.

Open sightlines.

Recognisable circulation nodes.

Distinct architectural landmarks.

Clear spatial hierarchy.

Conference centres with poor visual continuity exhibited greater user disorientation despite extensive directional signage.

Biophilic and Environmental Design

Environmental design significantly influenced users' spatial experience.

The most successful facilities incorporated:

Natural daylight.

Landscaped courtyards.

Vegetation.

Outdoor gathering spaces.

Visual connections to nature.

Environmentally responsive public spaces.

These elements enhanced environmental comfort while simultaneously serving as orientation landmarks that improved cognitive mapping.

Major Findings

The comparative analysis demonstrates that:

High spatial integration significantly improves circulation efficiency.

Clear circulation hierarchy strengthens accessibility and movement.

Visual openness enhances spatial intelligibility.

Environmental landmarks improve intuitive wayfinding.

Biophilic design contributes not only to environmental quality but also to spatial orientation.

Conference-centre performance is highest where configurational planning and environmental design are integrated rather than treated independently.

Implications for the Proposed International Conference Centre, Aluu

The findings provide direct guidance for the proposed International Conference Centre in Aluu.

The design should incorporate:

A highly integrated circulation network.

Clearly defined movement hierarchy.

Central circulation spine.

Multiple visual connections.

Landscaped circulation corridors.

Natural daylight throughout public circulation areas.

Ecological landmarks supporting wayfinding.

Flexible public spaces that combine circulation with social interaction.

These strategies collectively informed the development of the Ecological Conference Boulevard (ECB), which integrates Space Syntax principles with biophilic design to create circulation systems that are efficient, environmentally responsive, and user-centred.

The comparative case studies demonstrate that conference-centre performance depends on the integration of efficient spatial configuration and environmental design. While Space Syntax provides measurable principles for improving accessibility, connectivity, and circulation efficiency, biophilic design strengthens environmental quality, cognitive mapping, and user experience. The synthesis of these findings forms the empirical basis for the Ecological Conference Boulevard (ECB), which serves as the study's proposed planning framework for optimising circulation efficiency and wayfinding in the proposed International Conference Centre, Aluu, Rivers State.

RESULTS AND DISCUSSION

Overview

This study investigated how the integration of Space Syntax principles and biophilic design strategies can improve circulation efficiency and wayfinding in the proposed International Conference Centre, Aluu, Rivers State. The findings are presented according to the two research objectives and interpreted in relation to the reviewed literature and theoretical framework. The comparative case studies reveal that circulation performance depends not only on spatial configuration but also on environmental characteristics that influence users' perception, orientation, and movement.

Research Objective One

To evaluate the influence of Space Syntax and biophilic design principles on circulation efficiency and wayfinding through a comparative analysis of selected international conference centres.

Circulation Efficiency

The comparative analysis indicates that spatial configuration is a primary determinant of circulation efficiency. Conference centres with highly integrated layouts, strong connectivity, and logical functional zoning consistently demonstrated smoother pedestrian movement, reduced travel distances, and improved accessibility.

Facilities such as the International Conference Centre Geneva and the United Nations Conference Centre exhibited superior circulation performance because their layouts provided direct connections between major functional spaces while maintaining clear circulation hierarchies. These findings support Space Syntax Theory, which proposes that highly integrated spatial systems encourage efficient movement and minimise congestion (Hillier & Hanson, 1984; Hillier, 1996).

Conversely, facilities characterised by elongated corridors, fragmented layouts, or limited visual connections relied more heavily on directional signage and experienced reduced circulation efficiency. These observations suggest that poor spatial integration increases users' cognitive effort and reduces overall building performance.

Wayfinding Performance

The findings demonstrate that effective wayfinding depends primarily on architectural organisation rather than signage. Buildings incorporating open sightlines, recognisable circulation nodes, central atria, and clear spatial hierarchies enabled users to navigate unfamiliar environments with greater confidence and accuracy.

Visual connectivity emerged as one of the strongest contributors to intuitive navigation. Visitors were able to identify destinations more easily where major circulation routes maintained continuous visual relationships with entrances, gathering spaces, and key activity areas.

These findings reinforce the work of Arthur and Passini (1992) and Passini (1996), who argued that architecture itself should function as the principal wayfinding system.

Influence of Biophilic Design

The study further demonstrates that biophilic design significantly complements circulation planning. Natural lighting, vegetation, landscaped courtyards, outdoor gathering spaces, and environmental landmarks not only improved environmental quality but also enhanced users' cognitive mapping and spatial orientation.

Buildings incorporating extensive daylight and landscape integration provided stronger visual reference points that reduced confusion and improved movement through complex spaces. Rather than functioning solely as aesthetic or environmental interventions, these natural elements contributed directly to circulation efficiency by strengthening spatial legibility.

This finding extends previous studies that primarily associated biophilic design with health, comfort, and sustainability by demonstrating its practical contribution to movement behaviour and wayfinding.

Research Objective Two

To develop the Ecological Conference Boulevard (ECB) as an integrated architectural framework for improving circulation efficiency, spatial intelligibility, and user experience in the proposed International Conference Centre, Aluu, Rivers State.

Development of the Ecological Conference Boulevard (ECB)

The comparative findings informed the development of the Ecological Conference Boulevard (ECB), an integrated planning framework that combines the analytical principles of Space Syntax with the environmental qualities of biophilic design.

Unlike conventional circulation corridors designed solely for movement, the ECB conceptualises circulation as a multifunctional architectural system that simultaneously supports:

efficient pedestrian movement;

intuitive wayfinding;

environmental sustainability;

social interaction;

cognitive orientation; and

enhanced user experience.

Within the proposed framework, circulation routes become active public spaces incorporating natural lighting, vegetation, landscape corridors, water features, environmental landmarks, and visually connected gathering areas.

Spatial Integration

The ECB promotes highly integrated circulation networks through:

central circulation spines;

interconnected public spaces;

direct functional relationships;

balanced horizontal and vertical circulation;

simplified movement patterns.

These strategies reduce unnecessary travel distances while improving accessibility throughout the conference centre.

Environmental Legibility

A major contribution of the ECB is its emphasis on environmental legibility. Instead of relying predominantly on signage, users navigate through identifiable architectural and ecological features.

Natural elements including landscaped courtyards, daylight-filled atria, tree-lined walkways, and water features serve as orientation landmarks that reinforce spatial memory and cognitive mapping.

Consequently, movement becomes more intuitive while reducing users' dependence on external directional systems.

User Experience

The integration of environmental and configurational strategies creates circulation environments that are comfortable, visually engaging, and psychologically supportive.

The ECB transforms movement spaces into social environments where visitors can interact, rest, and orient themselves while maintaining efficient circulation. This approach strengthens the functional performance of conference centres while enhancing visitor satisfaction and environmental quality.

DISCUSSION

The findings demonstrate that circulation efficiency cannot be explained solely through spatial configuration or environmental quality independently. Rather, effective conference-centre design requires the integration of both dimensions.

Space Syntax Theory successfully explains how spatial organisation influences accessibility, connectivity, and movement behaviour, whereas Biophilic Design Theory explains how environmental qualities influence users' perception, cognition, and comfort.

The study therefore confirms that combining these theoretical perspectives produces a more comprehensive understanding of conference-centre circulation than either theory alone.

This integrated perspective addresses an important limitation within previous research, where configurational analysis and environmental design have generally been investigated separately.

Contribution to Architectural Knowledge

The principal contribution of this study lies in the development of the Ecological Conference Boulevard (ECB).

Unlike previous studies that focus primarily on evaluating existing circulation performance, this research proposes a transferable architectural planning framework that integrates:

Space Syntax principles;

Biophilic Design strategies;

circulation planning;

wayfinding;

environmental quality; and

user-centred design.

The framework demonstrates that ecological infrastructure can simultaneously function as:

circulation space;

orientation device;

environmental system;

social interaction corridor; and

architectural identity.

This integrated approach represents a significant advancement in evidence-based conference-centre planning.

The study established that:

Highly integrated spatial layouts improve circulation efficiency and accessibility.

Clear circulation hierarchy enhances movement and reduces congestion.

Visual connectivity strengthens intuitive wayfinding.

Environmental landmarks improve spatial orientation.

Biophilic design contributes to both environmental quality and movement behaviour.

The integration of Space Syntax and biophilic design produces superior conference-centre performance.

The Ecological Conference Boulevard (ECB) provides an evidence-based planning framework capable of improving circulation efficiency, wayfinding, environmental sustainability, and user experience in future conference-centre developments.

CONCLUSION

This study examined how Space Syntax principles and biophilic design strategies can be integrated to optimise circulation efficiency and wayfinding in the proposed International Conference Centre, Aluu, Rivers State, Nigeria. Through a qualitative multiple case study of five conference centres, the research demonstrated that spatial configuration and environmental quality are complementary determinants of building performance.

The findings confirm that conference centres characterised by high spatial integration, strong connectivity, clear circulation hierarchy, and visual openness consistently achieve better accessibility, reduced pedestrian congestion, improved wayfinding, and enhanced user experience. Similarly, biophilic elements including natural lighting, vegetation, landscape corridors, environmental landmarks, and open public spaces not only improve environmental quality but also strengthen spatial legibility and users' cognitive orientation.

The study establishes that neither Space Syntax nor Biophilic Design alone provides a complete solution to circulation challenges in complex public buildings. Rather, their integration offers a comprehensive framework that simultaneously improves movement efficiency, environmental responsiveness, and spatial experience.

Consequently, the proposed Ecological Conference Boulevard (ECB) represents an evidence-based architectural framework that reconceptualises circulation as a multifunctional system supporting movement, orientation, environmental sustainability, and social interaction. The framework provides a practical planning model for conference-centre architecture and contributes to the advancement of evidence-based architectural design.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

Conference centres should adopt highly integrated spatial layouts to improve circulation efficiency, minimise travel distances, and reduce pedestrian congestion.

Circulation planning should prioritise architectural legibility through clear spatial hierarchy, visual connectivity, and logical functional relationships rather than relying predominantly on signage.

Biophilic design strategies should be integrated into circulation systems by incorporating natural lighting, vegetation, landscaped corridors, water features, and environmental landmarks that support intuitive wayfinding and enhance environmental quality.

Architects should incorporate the Ecological Conference Boulevard (ECB) as a planning framework for designing conference centres that combine efficient circulation with environmental sustainability and user-centred spatial experiences.

Future conference-centre developments in Nigeria should adopt evidence-based design approaches that integrate configurational analysis with environmental design to improve operational efficiency and visitor satisfaction.

Planning authorities and policymakers should encourage the use of evidence-based architectural frameworks during the conceptual design stage of major public facilities to promote sustainable and accessible built environments.



Fig 7.1: Picture showing the Ecological Conference Boulevard.

Source: (Author 2026).

Contribution to Knowledge

This study makes several important contributions to architectural research and conference centre planning.

First, it extends the application of Space Syntax Theory beyond its traditional use in hospitals, educational facilities, airports, museums, and urban environments by demonstrating its relevance to conference-centre architecture.

Second, the study broadens the application of Biophilic Design by showing that natural elements contribute not only to environmental quality and occupant well-being but also to circulation efficiency, spatial orientation, and intuitive wayfinding.

Third, the research develops the Ecological Conference Boulevard (ECB) as a novel architectural framework integrating configurational analysis with ecological design. Unlike previous studies that evaluate circulation performance independently of environmental quality, the ECB provides a unified planning strategy that simultaneously enhances movement efficiency, spatial intelligibility, environmental responsiveness, and user experience.

Finally, the study contributes a practical and transferable evidence-based planning model that architects, planners, and policymakers can apply during the conceptual design of future conference centres and other complex public buildings.

Limitations of the Study

The study relied exclusively on secondary documentary data obtained from published architectural documentation, scholarly literature, project reports, and official sources. Consequently, the findings are dependent on the availability and quality of existing documentation.

The investigation was limited to five purposively selected conference centres, which, although appropriate for qualitative comparative analysis, may not represent all conference-centre typologies or regional planning contexts.

In addition, the study did not undertake computational Space Syntax simulations or post-occupancy behavioural observations, which could provide quantitative validation of the proposed framework.

Despite these limitations, the multiple-case comparative approach, triangulation of documentary evidence, and integration of established theoretical frameworks provide a robust basis for the development of the proposed Ecological Conference Boulevard (ECB).

Implications for Future Research

Future research should validate the proposed Ecological Conference Boulevard (ECB) using computational Space Syntax software, pedestrian simulation models, and post-occupancy evaluations of completed conference centres.

Further investigations may also examine the applicability of the framework to other complex public building types, including exhibition centres, convention complexes, airports, cultural institutions, and mixed-use civic developments.

Comparative studies involving additional regional and international conference centres would further strengthen the empirical foundation of the framework and support its wider adoption within evidence-based architectural practice.

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