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Exploring Outdoor Public Spaces: A Comprehensive Literature Review on Assessment Approaches

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Abstract

This comprehensive literature review provides a thorough examination of assessment approaches for outdoor public spaces, emphasising their crucial role in enhancing sustainability and quality. The review synthesises existing research to examine various methodologies used for evaluating outdoor spaces, including traditional assessment methods and emerging approaches, along with their integration into sustainable construction solutions. Relevant case studies are presented to demonstrate the potential for enhancing the environmental and social performance of public spaces. The review identifies opportunities for future research and practice through critical analysis and gap identification, accenting the need for a more integrated and holistic approach to assessment. The findings of the review offer valuable insights for those involved in urban planning and design, including practitioners, policymakers, researchers, and community members, encouraging collaboration and innovation in creating healthier, more resilient, and more lively urban environments.

1. Introduction

1.1. Background and Context

Urbanisation is an ongoing global phenomenon, with more than half of the world's population residing in urban areas (Chadchan and Shankar 2009; Brook and Dávila 2000; Watson 2008). As cities continue to expand, the importance of outdoor public spaces becomes increasingly evident. These spaces are vital components of urban life, providing opportunities for recreation, social interaction, cultural expression, and environmental sustainability (Andersson 2016; Johnson and Glover 2013). However, rapid urbanization and population growth present numerous challenges in ensuring the quality, accessibility, and sustainability of public spaces (Chitrakar, Baker, and Guaralda 2017).

In recent years, there has been a growing recognition of the need to assess and evaluate outdoor public spaces systematically (Ma, Su, and Tu 2023; Mehta 2014). Assessment approaches play a crucial role in understanding the performance, functionality, and user experience of these spaces. By examining various aspects such as design, amenities, accessibility, safety, and environmental impact, assessment methods help identify strengths, weaknesses, and opportunities for improvement.

Moreover, the concept of sustainable development has gained projection in urban planning and design (Yigitcanlar and Kamruzzaman 2019; Dempsey et al. 2011). Sustainable construction practices aim to minimize environmental impact, conserve resources, and enhance the resilience of built environments (Azis et al. 2012; Kashiripoor 2023; Iskandar, Nelson, and Tehrani 2022). Integrating sustainable construction solutions into the development of outdoor public spaces not only promotes environmental control but also contributes to the overall well-being and quality of life of urban residents (Nuzhina, Zolotareva, and Vasileva 2018; Mouratidis 2021; Constantinescu et al. 2019).

Against this background, this literature review aims to provide a comprehensive examination of assessment approaches for outdoor public spaces and their integration with sustainable construction solutions.

1.2. Purpose of the Literature Review

The purpose of this literature review is to identify key trends, challenges, and opportunities in the field by synthesising existing research. It also seeks to inform future research, policy, and practice in urban planning and design through critical analysis and gap identification.

1.3. Scope and Objectives

This literature review covers a broad range of assessment methods, including traditional techniques like surveys and observation, as well as newer technologies such as GIS-based analysis, virtual reality simulations, sensor technologies, and social media analytics. Case studies of sustainable construction projects in outdoor public spaces will be examined to highlight successful implementation strategies and innovative approaches.

The objectives of this literature review are as follows:

i. To explore the diverse methodologies used to evaluate outdoor public spaces.
ii. To examine the integration of assessment approaches with sustainable construction solutions.
iii. To identify gaps, challenges, and opportunities for future research and practice.
iv. To provide insights for practitioners, policymakers, researchers, and community stakeholders involved in urban planning and design.

1.4. Structure of the Review

The review is structured to facilitate a comprehensive exploration of assessment approaches for outdoor public spaces and their integration with sustainable construction solutions.

The review begins with an introduction to the background and context of the topic, highlighting the importance of outdoor public spaces in urban environments and the need for effective assessment methods to ensure their sustainability and quality. This sets the stage for a detailed examination of the literature, aiming to identify key themes, trends, and gaps in existing research.

Following the introduction, the review is divided into several thematic sections, each focusing on specific aspects of assessment approaches and sustainable construction solutions:

Section 2 – Outlines the methodological approach used to conduct the literature review. It describes the search strategy, selection criteria, data collection and analysis methods, and any planned quantitative analyses, such as bibliometric analysis using Bibliometrix R-tool and biblioshiny app.

Section 3 – Explores traditional and emerging assessment methods used to evaluate the quality and performance of outdoor public spaces. It explores the importance of assessment

in urban planning and design, highlighting the role of assessment approaches in shaping the built environment and enhancing the liveability of cities.

Section 4 – Investigates the concept of sustainable construction and its significance in the development of outdoor public spaces. It discusses the importance of integrating sustainable practices into construction projects and presents case studies of innovative sustainable construction projects from around the world.

Section 5 – Critically analyses existing assessment approaches and explores opportunities for integrating these approaches with sustainable construction solutions. It identifies gaps in current research and suggests avenues for future research studies aimed at enhancing the sustainability and resilience of outdoor public spaces.

Section 6 – Synthesizes bibliometric analysis results and key findings from the literature review, accenting interdisciplinary collaboration, stakeholder engagement, and future trends. It underscores the importance of integrating modernity with tradition for sustainable urban environments.

The conclusion summarises the insights from the literature review on assessment approaches for outdoor public spaces, emphasising the importance of balancing modernity with tradition and promoting sustainability.

2. Methodology

2.1. Search Strategy

A systematic search strategy was developed to identify relevant publications from academic databases, including Google Scholar, Scopus, and Web of Science. The search strategy incorporated predefined search terms related to assessment approaches, outdoor public spaces, sustainability, and construction solutions. These terms included variations and synonyms of key concepts, such as "assessment methods," "evaluation approaches," "public space design," "sustainable construction," and "urban quality." The search strategy used Boolean operators (such as “AND,” “OR,” and “NOT”) to combine these terms and refine search queries for improved search precision.

2.2. Selection Criteria

Articles were screened for relevance based on predefined inclusion criteria. Eligible publications were required to address assessment approaches for outdoor public spaces, with a primary emphasis on methodologies, case studies, and innovative approaches. The inclusion criteria also considered the integration of assessment approaches with sustainable construction solutions, reflecting the interdisciplinary nature of the topic. Additionally, the selection process aimed to ensure diversity in geographical contexts, study designs, and disciplinary perspectives to provide a comprehensive overview of the literature.

2.3. Data Collection and Analysis

Data collection involved the systematic retrieval of relevant literature from academic databases, followed by a screening of titles, abstracts, and full-text articles to identify eligible studies. Thematic synthesis and critical consideration were conducted to analyse the data, identify key themes and trends, and assess the quality of the literature. Gap identification was also performed to identify areas for future research and practice. The methodology employed a flexible and interpretive approach to synthesise existing research, enabling nuanced insights and a comprehensive understanding of the topic.

In addition to the qualitative synthesis of the literature, a small bibliometric analysis will be conducted using Bibliometrix R-tool and biblioshiny app (web-interface). This analysis aims to

provide a quantitative overview of the selected literature, complementing the qualitative insights gained from the narrative review. The bibliometric analysis will investigate publication trends, citation networks, authorship patterns, keyword frequencies, and journal sources to identify trends, patterns, and relationships within the literature.

2.4. Limitations and Considerations

It is important to acknowledge the limitations of the methodology, including potential biases in the selection of literature, language restrictions, and the focus on recent publications.

For instance, the reliance on English-language publications may have excluded relevant studies published in other languages, and the case of concentrating on peer-reviewed sources may also have ignored valuable information from grey literature or non-academic reports.

Despite these limitations, the methodology aimed to provide a comprehensive overview of assessment approaches for outdoor public spaces and their integration with sustainable construction solutions, to inform practice, policy, and research in urban planning and design.

3. Assessment Approaches for Outdoor Public Spaces

3.1. Traditional Assessment Methods

Traditional assessment methods have long been used to evaluate outdoor public spaces, providing valuable insights into user perceptions, preferences, and behaviours (Monsoureh-Rezasoltani and Said 2012). These methods often include surveys, questionnaires, interviews, and direct observation, allowing researchers and practitioners to gather data on user satisfaction, safety, accessibility, and usability (Monsoureh-Rezasoltani and Said 2012). Surveys and questionnaires, for example, can be used to collect quantitative data on user preferences for amenities, aesthetics, and functionality, while direct observation enables researchers to observe user behaviour and interactions within the space. Figure 1 illustrates the traditional assessment methods commonly employed to evaluate outdoor public spaces.

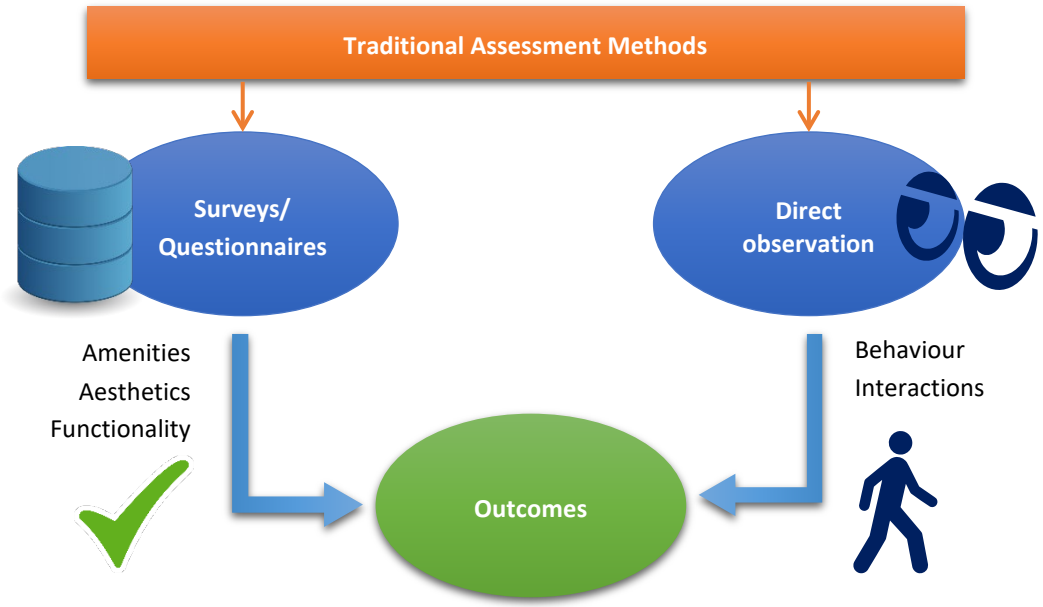


Figure 1: Traditional assessment methods for outdoor public spaces

Combining visual and structured methodologies can enhance the credibility and consistency of research methods (Monsoureh-Rezasoltani and Said 2012). Additionally, remote sensing techniques such as satellite imagery and Street View technology have been suggested as effective means of evaluating public space quality (Szczepańska and Pietrzyk 2020).

Furthermore, the use of guided walks has been suggested as a method for evaluating the spatial accessibility of public buildings (Andrade and Ely 2012).

3.2. Emerging Assessment Approaches

Recent developments in data analytics, sensor technologies, and Geographic Information Systems (GIS) have expanded the range of assessment methods for outdoor public spaces. Morar, Bertolini, and Radoslav (2013) and Nicholls (2001) both underline the application of GIS in assessing pedestrian accessibility and gauging the accessibility and fairness of public parks, respectively. Figure 2 illustrates a possible use of these technologies in the assessment of pedestrian traffic in urban public spaces related to tourist visits.

Figure 2: Various ArcGIS milestones that are useful for comparison or statistical use (García-Valldecabres et al. 2023)

For instance, this technology can be used for other purposes, such as analysing pavement wear and tear or selecting routes. These investigations highlight GIS's potential to offer more precise and comprehensive insights into public space performance.

Schootman et al. (2016) highlight the usefulness of new technologies such as Google Street View, social media platforms, drones, webcams and crowdsourcing in assessing neighbourhood conditions, which can be extended to public spaces.

Lastly, Nemec and Raudsepp-Hearne (2012) investigate the use of GIS in mapping and assessing ecosystem services, which is also relevant for evaluating public spaces. These studies highlight the significant impact of emerging technologies on the assessment of outdoor public spaces.

Thus, GIS-based analysis enables researchers to examine spatial patterns, connectivity, and accessibility within urban environments. Sensor technologies facilitate real-time monitoring of environmental conditions, such as air quality, noise levels, and pedestrian traffic.

Virtual reality simulations and social media analytics can be used as additional tools to assess user perceptions and experiences in outdoor public spaces. These platforms provide immersive and interactive ways to collect and analyse data.

Schrom-Feiertag et al. (2020) and Camilleri et al. (2013) both underscore the potential of virtual reality (VR) simulations for data collection and analysis in public spaces. Schrom-Feiertag's research in urban planning demonstrates the value of VR in soliciting feedback, while Camilleri's case studies in corporate training and higher education show how immersive environments can enhance engagement and learning. Eghbali, Väänänen, and Jokela (2019) and Simone (2018) explore the user experience in VR. Eghbali identifies crucial factors for social acceptability, while Simone discusses methods for measuring user quality of experience in social VR systems. These studies demonstrate the potential of VR simulations and social media analytics for evaluating user perceptions and experiences in outdoor public spaces.

3.3. Importance of Assessment in Urban Planning

The assessment of outdoor public spaces is essential for informing urban planning and design decisions, ensuring that public spaces are functional, accessible, and responsive to the needs of diverse user groups.

Multiple studies underscore the significance of evaluating outdoor public spaces to guide urban planning and design decisions. Francis (2003) and Mehta (2014) both emphasise the importance of public spaces being adaptable to user needs, inclusive in accessibility, and meaningful for the community. Schrenk et al. (2013) further emphasise the varied requirements of different user demographics, including those with limited mobility or sensory impairments, and stress the importance of inclusive design practices. Errante (2020) highlights the significance of physical, social, and cultural accessibility in shaping urban commons, emphasising the necessity of accurately understanding these factors.

Collectively, these studies emphasise the crucial role of assessment in ensuring that public spaces are functional, accessible, and responsive to the diverse needs of users. Systematic evaluation of public spaces enables planners and designers to identify areas for improvement, prioritize investments, and optimize resource allocation.

As follows, assessment approaches also play a critical role in promoting sustainability and resilience in urban environments, helping to mitigate the impacts of climate change, promote biodiversity, and enhance the overall quality of life for residents. Palacký, Františák, and Wittmann (2015) stress the importance of continuously monitoring and fostering the development of urban open spaces, while Mehta (2014) suggests the implementation of a public space index to evaluate inclusivity, significance, safety, comfort, and enjoyment. Lopes and Camanho (2013) utilize the Data Envelopment Analysis technique to identify effective practices for enhancing urban liveliness through the utilization of public green spaces. Pera (2020) point up the importance of sustainable urbanism and networked public governance in guiding urban transformations towards sustainability and resilience.

These studies demonstrate the importance of systematic evaluation in promoting sustainable and resilient urban environments.

4. Sustainable Construction Solutions in Outdoor Public Spaces

4.1. Concept of Sustainable Construction

According to Majdalani, Ajam, and Mezher (2006), sustainable construction involves taking into account environmental, socio-economic, and cultural factors, with the goal of promoting efficient resource utilization, social equity, and economic viability. The need for sustainable

construction in developing countries is emphasised by Reffat (2006), who underscores the importance of resource management, shared responsibility, and quality enhancement. Exploring this concept further, Zavadskas, Šaparauskas, and Antuchevičienė (2018) present various methodologies and tools for achieving sustainability in construction engineering. Grierson (2009) highlights the comprehensive approach of sustainable building design, which accounts for the entire building lifecycle and aims to minimise environmental impact.

The concept of sustainable construction in outdoor public spaces focuses on decreasing energy consumption, extending building lifespan, and reducing waste generation (Plank 2008). However, the construction sector's efforts to promote sustainable principles and practices are presently insufficient (Maduka et al. 2016). Water conservation is also essential, with the adoption of recycled water and rainwater harvesting being recommended (Rahman et al. 2019). A framework for sustainable construction, which integrates social, economic, biophysical, and technical dimensions, has been put forward (Hill and Bowen 1997).

Summarising, in the context of outdoor public spaces, sustainable construction involves incorporating environmentally friendly materials, optimising energy efficiency, and minimising waste generation throughout the lifecycle of the space. Key principles of sustainable construction include energy efficiency, water conservation, waste reduction, and the use of renewable materials.

4.2. Importance of Sustainable Construction

Incorporating sustainable construction solutions into outdoor public spaces is vital for adopting environmental stewardship, resilience to climate change, and healthier communities (Asad 2007; Ochieng et al. 2014). This objective can be reached through the implementation of sustainable development practices, which have the potential to enhance quality of life and reduce operational expenses (Ochieng et al. 2014). Besides, the planning and design of public spaces can significantly contribute to climate change mitigation and adaptation efforts, resulting in numerous co-benefits for human health (Orsetti et al. 2022). To effectively address the challenges associated with integrating these solutions, it is essential to consider a range of technological, nature-based, and social approaches, with a particular focus on prioritising cities in systematically disadvantaged countries (Lin et al. 2021).

Adopting sustainable construction practices, such as incorporating high thermal resistivity materials and implementing cool facades, has been shown to effectively alleviate the urban heat island effect (Kandya and Mohan 2018; Hong et al. 2022). These practices also contribute to the reduction of air and water pollution by decreasing energy consumption and CO_2 emissions associated with building operations (Rahman et al. 2019). Additionally, the utilisation of high-albedo surfaces, such as light-coloured roofs and roads, offers an additional means of mitigating the urban heat island effect while conserving energy (Rosenfeld et al. 1995).

It should also be noted that the vernacular techniques used in outdoor public spaces are an integral part of urban design, serving as reflections of the cultural and social fabric of a community (Butsykina 2020). These methods also have the potential to enhance sustainable building practices, particularly when integrated with digital technologies and local manufacturing processes (Priavolou et al. 2021). Small architectural elements such as gazebos and verandas play pivotal roles in shaping open public spaces, with their design prioritising functionality and sustainability (Kalinichenko, Kurochkina, and Belova 2021). In regions characterised by hilly terrain, vernacular construction practices can inform building codes,

ensuring that new developments harmonize with the local context and adhere to sustainable principles (Kumar and Pushplata 2013).

Elements of green infrastructure like green roofs, rain gardens, and permeable pavements play crucial roles in providing ecosystem services within outdoor public spaces. These services embrace stormwater management, habitat creation, and carbon sequestration (Gonzalez-Meler et al. 2013). Implementing multifunctional green infrastructure can amplify urban ecosystem services, thereby contributing to the sustainable social and ecological well-being of cities (Lovell and Taylor 2013). Of these elements, green roofs stand out for their diverse benefits, which include improved stormwater management, regulation of building temperatures, and the creation of urban wildlife habitats (Oberndorfer et al. 2007). Furthermore, green infrastructure serves as a guiding framework for urban development, facilitating both economic growth and nature conservation efforts (Semeraro, Aretano, and Pomes 2017).

4.3. Case Studies of Sustainable Construction Projects

Several case studies and analyses have showcased the advantages of incorporating sustainable design principles into the development of public spaces. Ochieng et al. (2014) and Dobson et al. (2013) have both underlined the cost-effectiveness and enhanced environmental performance linked with sustainable construction practices. Chu (2016) and Li and Wang (2016) offer specific instances of innovative sustainable construction approaches, such as employing biocement and effectively managing contaminated waste. Shi, Zuo, and Zillante (2012) and Song and Liang (2011) stress the significance of establishing dedicated departments and implementing lean construction methodologies to advance sustainable construction efforts. Lastly, Miller and Doh (2015) and Sodangi (2018) explore the contribution of structural engineers to sustainable building design and the social sustainability aspect of construction projects. Together, these studies accentuate the significance of sustainable construction in public spaces, highlighting its dual benefits in terms of environmental preservation and economic viability.

A range of sustainable construction solutions has been proposed for outdoor public spaces, including the use of recycled materials (Rybak-Niedziółka et al. 2023; Patel and Patel 2021), energy-efficient lighting (Abdallah, El-Rayes, and Liu 2013), green roofs (Chu 2016), and rainwater harvesting systems (Rahman et al. 2019; Amado and Barroso 2013). These solutions not only reduce the environmental impact of construction but also contribute to the overall sustainability of public spaces.

Table 1 presents a summary of the relevant studies that showcase the integration of sustainable design principles into the development of public spaces.

Year	Author(s)	Article title	Summary
2014	Edward Ochieng, TS Wynn, Tarila Zoufa, X. Ruan, A. Price, C. Okafor	Integration of Sustainability Principles into Construction Project Delivery	Sustainable design has the potential to produce buildings that incur minimal operating expenses.
2015	Dane Miller, J. Doh	Incorporating sustainable development principles into building design: a review from a structural perspective including case study	To achieve sustainable structural designs, practitioners must adopt a systematic approach that begins with a standardised calculation procedure and the creation of a database for the embodied energy of building materials.
2017	Mohsen Sanei, Mina Khodadad, Farid Panahi Ghadim	Effective Instructions in the Design Process of Urban Public Spaces to Promote Sustainable Development	Urban public spaces that prioritise sustainability serve as pivotal locations where designers and managers can foster a meaningful connection between individuals and the cityscape.
2018	Soomi Kim, Hyun-ah Kwon	Urban Sustainability through Public Architecture	In public architectural design, it's important to address the avoidance of vacant urban spaces by employing architectural techniques and construction methods.
2021	Albert Fekete, Katarzyna Hodor, Daixin Dai	Urban Sustainability through Innovative Open Space Design. A Novel Approach to the Regeneration of Historic Open Spaces in Some Eastern European Countries and China	Urban open spaces have expanded significantly beyond their original function in the early 21st century.
2022	Z. Samadi, A.F. Bakri, E. Mohamed, M. Salman, L. Haidar	Third Millennium Approach for Revitalizing Heritage Outdoor Space	Integrating heritage preservation with sustainable development goals is emphasised, especially in urban revitalisation.
2023	F. Guo, R. Guo, H. Zhang, J. Dong, J. Zhao	A canopy shading-based approach to heat exposure risk mitigation in small squares	Utilising tree canopies as a climate change adaptation strategy can enhance the thermal comfort and safety of urban residents in small squares.
2024	N.M. Ahmed, P. Altamura, M. Giampaoletti, F.A. Hemeida, A.F.A. Mohamed	Optimising human thermal comfort and mitigating the urban heat island effect on public open spaces in Rome, Italy through sustainable design strategies	Development of a framework for urban designers to mitigate the impacts of urban heat islands (UHI) and improve the thermal comfort of public spaces in urban areas.

Table 1: Relevant studies on sustainable design principles for outdoor public spaces

These studies underscore the significance of integrating sustainable design principles into public spaces, highlighting its dual benefits in terms of environmental preservation and economic viability.

Miller and Doh (2015) highlight the pivotal role of structural engineers in delivering sustainable designs, while Sanei, Khodadad, and Ghadim (2017) and Kim and Kwon (2018) both emphasise the significance of environmental, social, and economic sustainability in urban public areas.

Case studies provided by Dewberry and Sherwin (2002) and Fekete, Hodor, and Dai (2021) showcase successful applications of sustainable design principles in public space development. Abraham et al. (2005) and Ochieng et al. (2014) discuss the challenges and potential solutions related to implementing sustainable design, with Ochieng proposing a

sustainable framework for construction projects. In addition, Yu et al. (2011) reinforce the importance of sustainable building design in achieving enduring sustainability.

5. Integration of Assessment Approaches with Sustainable Construction Solutions

5.1. Critique of Existing Assessment Approaches

Through critical examination of the aspects of existing assessment approaches, it is possible to identify opportunities for improvement and develop more robust and effective frameworks for evaluating the sustainability of outdoor public spaces with sustainable construction solutions. This will contribute to creating more resilient, inclusive, and environmentally friendly urban environments for future generations.

Numerous studies have highlighted the limitations of current evaluation approaches for outdoor public spaces, particularly in the context of sustainable construction solutions. Avramidou and Manika (2021) and Morano et al. (2021) both emphasise the need for a more comprehensive and integrated approach to evaluating urban open spaces, with a focus on factors such as bioclimatic design and the inclusion of anthropic-natural elements. This is further supported by Curwell and Cooper (1998) and Walton et al. (2005), who call for a more holistic and robust methodology for assessing sustainability in the urban context. Conte and Monno (2012) and Deakin and Reid (2014) propose the use of cross-scale and multi-scalar evaluation models, respectively, to address the limitations of current building-centric approaches. Dong et al. (2016) suggest the integration of various assessment methods to provide a more comprehensive evaluation of eco-city initiatives. These studies collectively underscore the need for a more inclusive, resilient, and environmentally friendly approach to evaluating outdoor public spaces, one that integrates sustainable construction solutions and addresses the complex and interconnected nature of urban environments.

Figure 2 identifies six key points of critique of existing assessment approaches, highlighting areas where current approaches may be lacking in comprehensiveness, rigour, integration, stakeholder engagement, adaptability, transparency, which determines effectiveness in promoting positive change. By visually organising these critiques, the figure provides a clear overview of the challenges and opportunities for improvement in assessing the sustainability of outdoor public spaces.

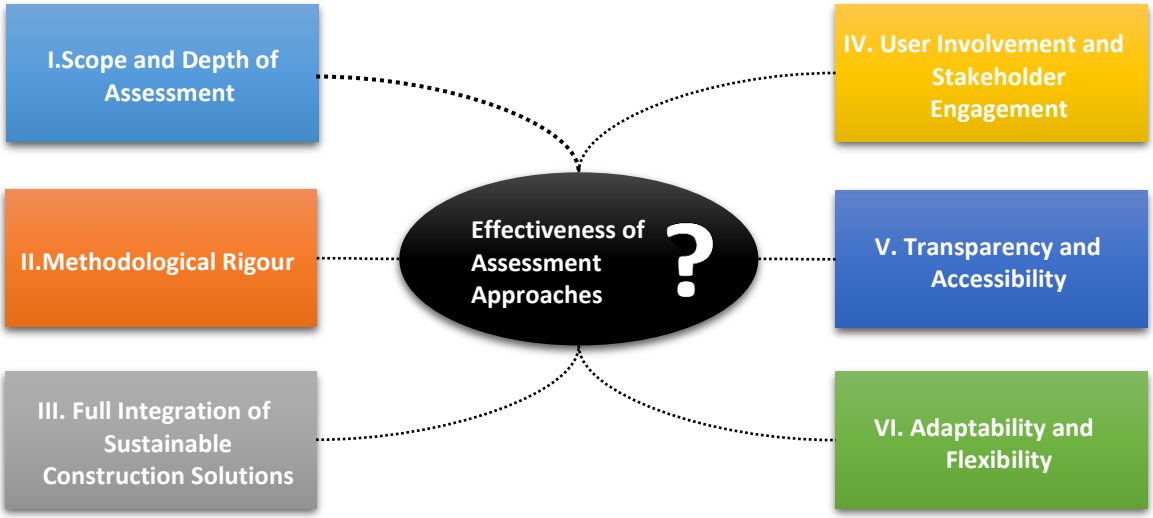


Figure 3: Critical key points of existing assessment approaches for outdoor public spaces

Current assessment approaches often fail to comprehensively cover relevant sustainability aspects in outdoor public spaces. Although they may address environmental factors, such as

energy efficiency and resource conservation, they may overlook crucial social and economic considerations. Furthermore, the depth of analysis may be insufficient, resulting in gaps in understanding the full impact of public space design and construction on sustainability.

Many current assessment approaches lack methodological rigour, relying on subjective criteria or outdated metrics. This can lead to inconsistencies and inaccuracies in the assessment process, which undermines the reliability of the results. Biases in the methodologies used may further skew the assessment outcomes and limit their validity.

Sustainable construction solutions are frequently treated as add-ons rather than being fully integrated into existing assessment frameworks. This approach can result in assessments failing to capture the full potential of sustainable construction in enhancing the overall sustainability of outdoor public spaces.

Meaningful engagement with end-users and stakeholders is essential. However, many existing approaches lack adequate mechanisms for involving diverse user groups and stakeholders in the assessment process. This can lead to a lack of representation of their needs and preferences, resulting in assessments that may not fully reflect the realities of public space usage.

Existing assessment approaches may lack adaptability and flexibility to accommodate different contexts and scales of outdoor public spaces. They may be overly prescriptive or rigid, making it challenging to tailor the assessment to specific site conditions or project requirements. Moreover, they may struggle to incorporate emerging trends and technologies in sustainable construction.

Transparency and accessibility are fundamental principles. However, many existing frameworks lack transparency in their data collection, analysis, and reporting practices. This can impede stakeholders' ability to comprehend and interpret the assessment results. Accessibility issues may arise if the assessment results are not readily available or easily understandable.

The effectiveness of assessment approaches is determined by their ability to drive positive change in public space design and construction practices. However, some existing approaches may not result in tangible improvements in sustainability outcomes due to barriers to implementation and uptake, such as cost constraints or lack of political will.

This critique provides a basis for developing evaluation frameworks that are more comprehensive and effective in addressing the complex and interconnected nature of urban environments.

5.2. Gap Analysis: Emerging Assessment Approaches

Building upon the critique of existing assessment approaches, this subsection conducts a gap analysis to identify emerging assessment approaches that are better suited for integrating sustainable construction solutions into the evaluation of outdoor public spaces.

Almahmoud and Doloi (2015) emphasise the importance of stakeholder satisfaction in achieving social sustainability, while Berardi (2012) highlights the need for a multi-dimensional approach, with a focus on energy performance. Curwell and Cooper (1998) and Pons-Valladares and Nikolic (2020) both identify a lack of common understanding and the need for quantifying and qualifying sustainability, respectively. Kajikawa, Inoue, and Goh (2011) and Rostamnezhad and Thaheem (2022) discuss the benefits and limitations of assessment frameworks, with the latter proposing a comprehensive framework for social sustainability. Kang and Rhee (2014) propose a systematic model for sustainable building assessment tools,

and Ding (2008) underscores the importance of integrating environmental considerations at the project appraisal stage.

These studies highlight the importance of a comprehensive, multi-faceted, and stakeholder-oriented approach to assessing sustainable construction solutions in public outdoor spaces.

Emerging assessment approaches for sustainable construction could combine modern and traditional or vernacular solutions, tools and technologies to allow for a more holistic and integrated assessment of sustainability performance. This includes considering factors such as life cycle assessment, resilience, social equity, and the urban quality of these construction solutions in general.

6. Results and Discussion

6.1. A Bibliometric Analysis

This subsection presents the findings of a bibliometric analysis conducted using Bibliometrix R-tool and Biblioshiny app (web-interface).

The Bibliometrix R-tool is a powerful software suite for bibliometric analysis, offering capabilities to map citation networks, analyse publication trends, and visualize co-authorship patterns. This helps identify influential research and emerging themes in the field.

The trends identified through bibliometric analysis, such as the growth in interdisciplinary collaborations and the rise of studies focusing on digital technologies, have practical significance for urban planning and policy. For instance, the increase in digital tools highlights the importance of equipping urban planners with training in emerging technologies to improve efficiency and decision-making. Similarly, the rise of interdisciplinary research underscores the need for collaborative frameworks that integrate diverse perspectives, enhancing the inclusivity and sustainability of urban development projects.

The findings are discussed about the broader themes and insights of the literature review, providing additional context and depth to the discussion.

The dataset consists of 274 scholarly documents gathered from 136 sources between 2014 and 2024. These documents have an average citation rate of 16.95 citations per document, indicating their significant impact within their respective fields. The average age of the documents is 3.22 years, suggesting relatively recent contributions to the academic literature.

Authors play a crucial role in contributing to this dataset, with 1051 unique authors identified. Collaboration among authors is common, with an average of 4.23 co-authors per document. However, international collaboration is relatively modest, accounting for only 10.58% of co-authorships.

In this study, articles are the predominant document type, comprising 162 documents. Additionally, a smaller number of books, book chapters, conference papers, proceedings papers, and reviews were also included.

The dataset contains 1786 Keywords Plus and 1236 Author's Keywords, reflecting the diverse range of topics covered within the dataset and providing insights into the thematic focus of the scholarly works.

Figure 3 shows the number of articles published each year from 2014 to 2023.

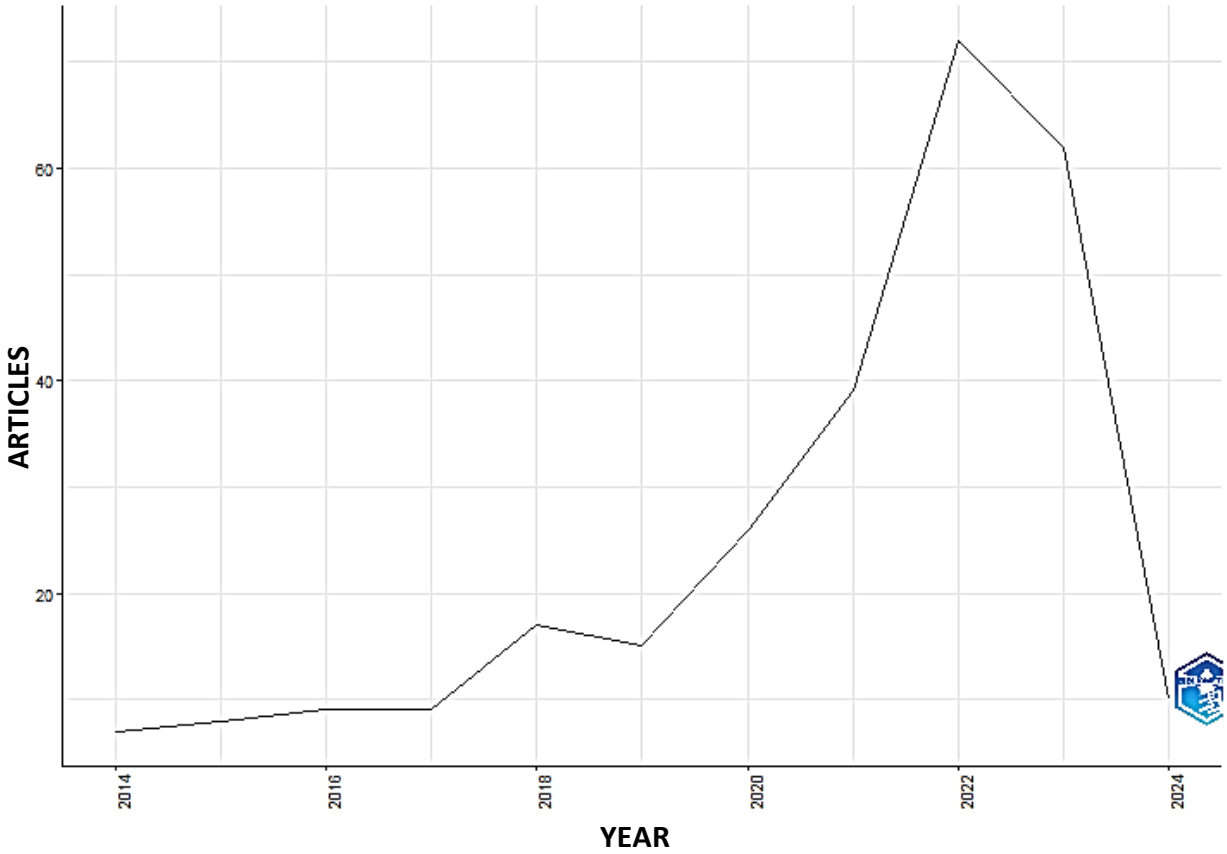
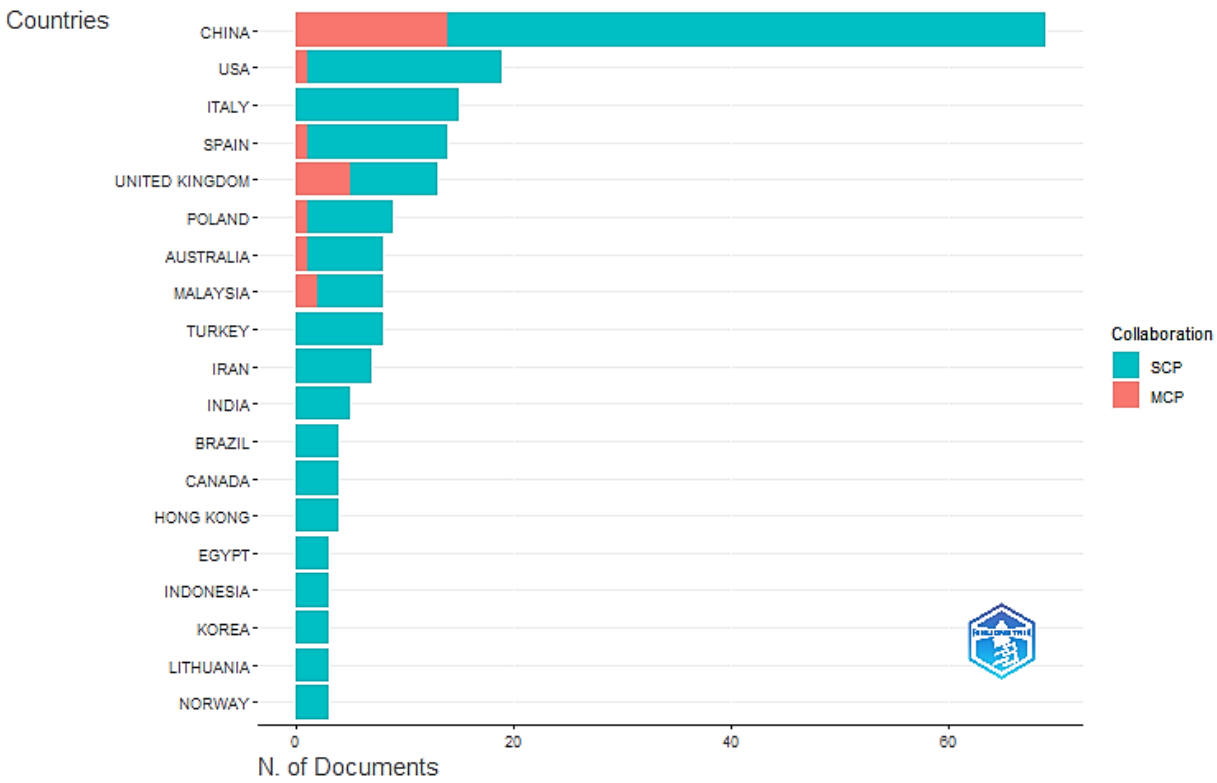


Figure 4: Annual Scientific Production (Aria and Cuccurullo 2017)

The data shows an evident upward trend in the number of published articles over the years, indicating a growing interest or emphasis on the subject matter. The steady increase from 2014 to 2023 suggests a sustained interest in the topic, with the publication output nearly doubling between 2021 and 2022. The significant jump in activity may indicate increased research or heightened relevance of the subject during that period. The data suggests a dynamic and evolving landscape in the field, with researchers contributing more to the discourse through their scholarly output.

Figure 4 illustrates the distribution of scientific production across different countries. It provides insights into the number of articles produced by each country, as well as the proportion of Single-Country Publications (SCP) and Multi-Country Publications (MCP) within their research output. The figure highlights notable trends in research collaboration and output, shedding light on the collaborative landscape in the field.



SCP: *Single Country Publications*, MCP: *Multiple Country Publications*

Figure 5: Scientific production across different countries (Aria and Cuccurullo 2017)

The analysis shows significant trends in research collaboration and output. China has the highest number of articles, with a considerable amount of its research output being single-country publications, indicating a robust domestic research base. The United States closely follows, with most of its publications also being single-country efforts. Italy, Spain, and the United Kingdom contribute to scientific production with varying degrees of collaboration with international partners. The Multi-Country Publication (MCP) Ratio provides insight into international collaboration levels. The United Kingdom shows a high ratio, indicating frequent collaborative efforts with researchers from other countries. Conversely, countries like Poland and Turkey exhibit lower MCP ratios, suggesting fewer collaborative endeavours with international peers.

The analysis of the co-occurrence network is significant as it provides valuable insights into the interconnectedness and importance of various topics within the network, as demonstrated in Figure 5.

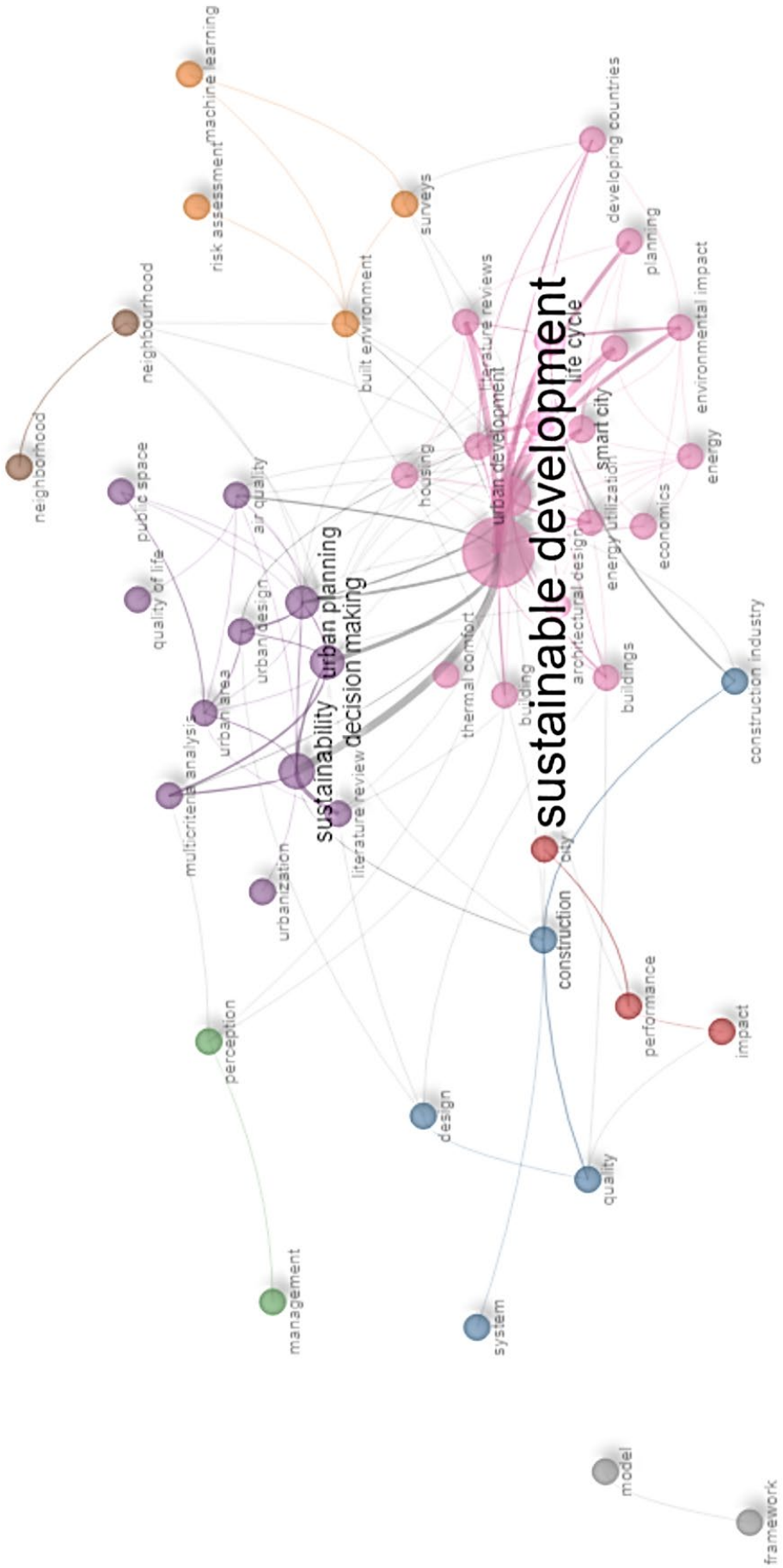


Figure 6: Co-occurrence network (Aria and Cuccurullo 2017)

Nodes such as urban planning, sustainable development and energy efficiency emerge as central and influential themes, playing a key role in connecting other nodes and shaping the overall structure of the network.

Urban planning stands out with high betweenness and PageRank scores, indicating its importance as a bridge between different themes and its influential role within the network. Similarly, sustainable development shows exceptional centrality and importance, underlining its critical role in connecting different topics and driving research discussions.

Also, nodes related to energy-related topics, such as energy efficiency and air quality, show remarkable influence and centrality within the network. Their high PageRank scores highlight their significant impact on the structure of the network and their key role in driving research conversations in their respective domains.

Overall, the analysis provides valuable insights into the dynamics of the co-occurrence network, highlighting key themes and their interconnections. By understanding the centrality and influence of specific nodes, researchers can identify important research trends and themes that are driving scholarly discussions in the field.

6.2. Summary of Key Findings

Table 2 provides a clear overview of the key findings from the literature review on approaches to the assessment of outdoor public spaces and their integration with sustainable building solutions, along with their respective descriptions. These findings include the core themes, emerging trends and key findings that emerged from the review.

Key findings	Description
Integration of Assessment Approaches	Indicates a holistic approach to development, highlighting the importance of integrating assessment approaches into sustainable building solutions.
Multidisciplinary Perspectives	Emphasises the importance of adopting a multidisciplinary perspective when assessing outdoor public spaces to ensure a comprehensive understanding of different aspects.
Emerging Technologies	Draws attention to the use of new technologies such as GIS, remote sensing, and advanced modelling techniques to improve the accuracy and efficiency of assessments.
Stakeholder Engagement	Recognises the critical role of stakeholder engagement in ensuring that assessments reflect the needs and aspirations of communities and promote inclusivity and transparency.
Challenges and Limitations	Identifies challenges, such as the lack of standardised frameworks and data accessibility issues, that can hinder the effectiveness and robustness of assessments.

Table 2: Summary of key findings

The key findings emphasise the importance of a comprehensive approach that incorporates different assessment methods into sustainable building practices. The focus on multidisciplinary perspectives underlines the need for diverse expertise to address the complexities of outdoor public spaces. Besides, the use of emerging technologies holds great promise for improving the accuracy and efficiency of assessments.

Furthermore, stakeholder engagement plays a critical role in ensuring that assessment processes are aligned with community needs and goals. However, challenges such as the lack of standardised frameworks and data accessibility issues are significant barriers to successful implementation.

6.3. Implications for Practice and Policy

Building on the summary of key findings, this section discusses the implications of the research findings for practice and policy in the fields of urban planning, design, and sustainability.

The research findings from the comprehensive literature review have profound implications for both practice and policy in the fields of urban planning, design, and sustainability.

The emphasis on integrating different assessment methodologies within sustainable building practices highlights the interrelation of elements within the built environment and calls for collaborative efforts that embrace multidisciplinary perspectives. Through the seamless integration of assessment approaches, practitioners can improve the resilience and functionality of outdoor public spaces.

Given the complexity of the urban environment, practitioners need to draw on expertise from a range of disciplines, including architecture, sociology, and environmental science. Interdisciplinary collaboration facilitates a comprehensive understanding of the relationships that shape outdoor public spaces, which is essential for informed decision-making.

Emerging technologies such as GIS and remote sensing offer promising opportunities to revolutionise assessment practices and enable accurate, efficient, and evidence-based assessments. However, realising their full potential requires investment in capacity building and equitable access across communities.

Stakeholder engagement is essential to gather perspectives, promote social cohesion and co-create inclusive outdoor environments that meet community needs. Despite progress, challenges such as a lack of standardised frameworks and data accessibility remain, requiring robust regulatory frameworks, improved data sharing, public-private partnerships, and capacity building initiatives.

6.4. Future Trends and Directions

This subsection outlines potential pathways for advancing assessment approaches for outdoor public spaces, building on evidence from current research and practice. It envisions future ways of promoting sustainability and resilience in urban environments by synthesising the implications for both practice and policy.

To illustrate the multifaceted nature of future trends and directions in the assessment of outdoor public spaces, a visual representation is provided in Figure 6.

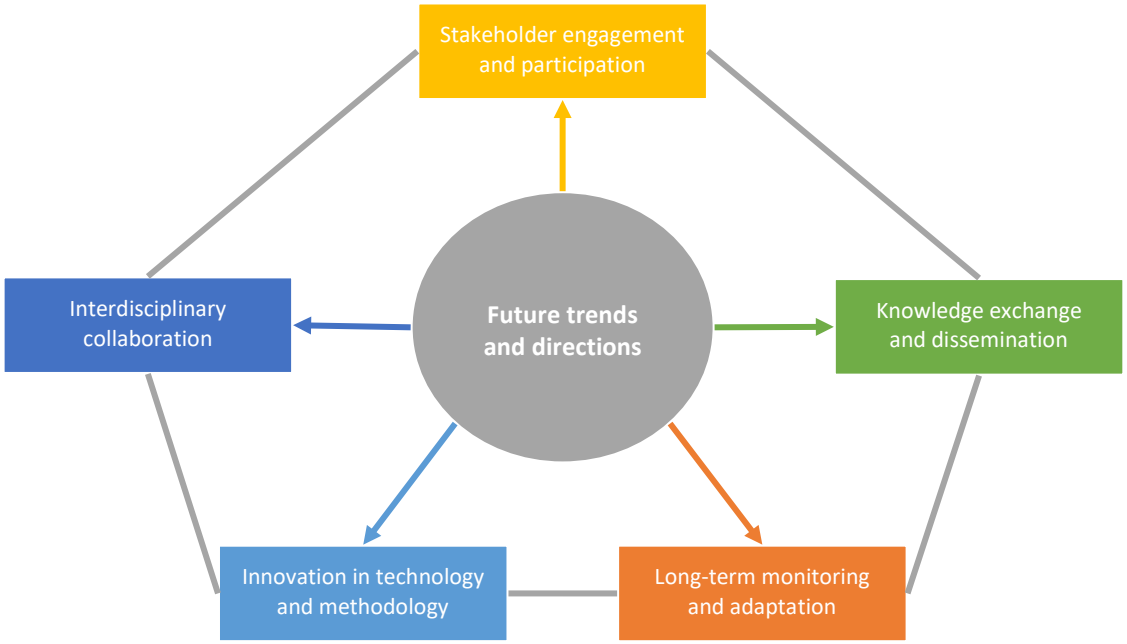


Figure 7: Future trends and directions

Interdisciplinary collaboration emphasises the need for collaboration between disciplines, so future efforts should seek to integrate knowledge from fields such as urban planning, architecture, environmental science, and sociology. By promoting interdisciplinary dialogue and collaboration, innovative solutions can be developed to address the multiple challenges of open space valuation.

In terms of stakeholder engagement and participation, recognising the importance of stakeholder engagement, future initiatives should prioritise the inclusive involvement of local communities, government agencies and private sector stakeholders. By incorporating diverse perspectives and co-creating solutions, the development of outdoor public spaces can better reflect the needs and aspirations of city residents.

Regarding knowledge exchange and dissemination, facilitating the exchange of knowledge and good practice is essential for progress in the evaluation of open spaces. Creating platforms for sharing research, case studies and practical ideas can enable practitioners and policy makers to learn from each other's experiences and promote the continuous improvement of evaluation methodologies.

Concerning long-term monitoring and adaptation, given the dynamic nature of urban environments, future efforts should emphasise the importance of continuous monitoring, assessment, and adaptive management strategies. By continually assessing the performance of public spaces and adapting interventions based on feedback and evolving conditions, practitioners can ensure their long-term sustainability and resilience.

Finally, relating to innovation in technology and methodology, harnessing the potential of emerging technologies and methodological advances is key to improving the efficiency and effectiveness of open space assessment. Future research should explore new approaches, such as the integration of artificial intelligence, sensor networks and participatory mapping techniques, to broaden the range of tools available to professionals.

However, embracing modernity while respecting tradition and local knowledge provides an opportunity to optimise urban quality through assessment approaches. Future research should explore innovative methodologies that integrate technological advances with

traditional and vernacular knowledge systems. Practitioners can create more culturally sensitive, contextually relevant, and sustainable solutions for assessing outdoor public spaces by combining cutting-edge technologies with time-tested practices. It explores how cities around the world are meeting the challenge of preserving historic heritage while embracing contemporary innovation and urbanisation trends.

Essentially, the future of approaches to assessing outdoor public spaces lies in embracing interdisciplinary collaboration, encouraging stakeholder engagement, promoting knowledge exchange, implementing adaptive management strategies, and harnessing technological innovation.

Lastly, new technologies such as machine learning hold potential to advance real-time monitoring and participatory assessment in urban design, offering innovative methods to enhance sustainability outcomes.

7. Conclusion

This literature review has provided a comprehensive examination of assessment approaches for outdoor public spaces and their integration with sustainable construction solutions. Through a critical analysis of existing literature, the review has highlighted the importance of balancing modernity and tradition, promoting sustainability and enhancing urban quality in the design and management of public spaces.

Key findings include the importance of incorporating sustainable design principles, user-centred approaches, and cultural sensitivity into assessment methodologies, as well as the potential of emerging technologies to enhance data collection, analysis and decision-making processes.

While significant progress has been made in understanding and advancing assessment approaches for outdoor public spaces, several opportunities for future research and practice remain. In this sense it is recommended that future studies focus on:

a) Further exploring the synergies between assessment approaches and sustainable construction solutions, with a particular emphasis on innovative methodologies and technologies that promote holistic and integrated assessments;
b) Investigating the social, economic, and environmental impacts of public space interventions, including their implications for community well-being, economic development, and environmental sustainability;
c) Examining the role of governance structures, policy frameworks, and regulatory mechanisms in shaping the design, management, and use of public spaces, with a focus on promoting equity, inclusivity, and resilience in urban environments;
d) Strengthening interdisciplinary collaboration, stakeholder engagement, and knowledge exchange to embrace innovation, creativity, and cross-sectoral partnerships in the planning, design, and management of public spaces.

To this extent, this literature review has underscored the importance of assessment approaches in shaping the quality, sustainability, and resilience of outdoor public spaces. Integrating sustainable construction solutions with assessment approaches can help practitioners, policy makers and researchers to create more vibrant, inclusive, and sustainable outdoor spaces that meet the diverse needs of communities, and to improve their performance to ensure that they remain vital and vibrant assets for current and future generations.

Urban planners should prioritise the use of emerging technologies for real-time data collection. Encouraging community participation in assessment processes ensures inclusivity

and context-sensitive solutions. Policymakers should invest in capacity-building initiatives to facilitate the adoption of sustainable practices, promoting resilience and long-term benefits for urban environments.

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