

Article

Research on Landscape Design and Management Innovation Based on Intelligent Technology

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Abstract: Against the backdrop of the coordinated advancement of digital infrastructure, smart city development, and ecological civilization construction, intelligent technologies—such as big data analytics, artificial intelligence, Building Information Modeling (BIM), Geographic Information Systems (GIS), the Internet of Things (IoT), digital twins, and virtual/augmented reality—are comprehensively permeating the landscape architecture industry. These technological advancements are fundamentally driving the transformation of landscape design and operation management from traditional, experience-based approaches to data-driven, intelligently collaborative, and low-carbon ecological models. This paper systematically reviews the diverse application types and core values of intelligent technologies within the landscape architecture field. Furthermore, it critically analyzes current practical issues hindering industry progress, such as fragmented landscape design processes, coarse and inefficient management practices, insufficient ecological quantification, and overall low operational efficiency. To address these challenges, this study constructs a comprehensive, intelligent technology-enabled landscape architecture innovation system structured across five critical dimensions: design innovation, construction innovation, management innovation, operation innovation, and service innovation. By thoroughly examining practical, real-world cases—including the development of smart parks, the implementation of digital twin green spaces, and the intelligent monitoring of sponge cities—the paper proposes robust implementation strategies. These strategies encompass accelerated technology adoption, specialized talent cultivation, and the establishment of institutional safeguards. Ultimately, this research provides essential theoretical references and actionable practical pathways for achieving high-quality, sustainable landscape architecture development in the modern digital era.

Keywords: intelligent technology; landscape architecture; landscape design; smart maintenance; management innovation; digital twin

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1. Introduction

As urban development in China progresses into a phase emphasizing refined governance, the scope of landscape architecture has expanded significantly [1, 2]. It now transcends traditional visual aesthetics and spatial design to encompass a wide array of critical functions. These include ecological restoration, stormwater management, carbon sequestration assessment, public service provision, cultural heritage preservation, and emergency shelter planning. However, conventional landscape design methodologies continue to encounter persistent challenges. These include reliance on subjective, experience-based planning approaches, difficulties in quantifying ecological impacts, insufficient coordination during construction phases, overly simplistic operational management practices, and delayed responses to service demands. Such limitations render traditional methods inadequate for addressing the complex requirements of modern urban development, particularly in the context of smart cities, resilient urban systems, and low-carbon urban initiatives. The need for innovative solutions is therefore paramount to meet these evolving demands effectively.

Intelligent technologies, including big data analytics, artificial intelligence (AI), building information modeling (BIM), geographic information systems (GIS), the Internet of Things (IoT), and digital twin systems, offer transformative solutions for the landscape architecture industry. These technologies enable comprehensive, end-to-end processes that are both visualized and smart. They facilitate precise on-site data collection, advanced ecological benefit simulations, automated design generation, and digital construction management. Additionally, they support real-time monitoring of green spaces and intelligent decision-making for maintenance activities. By integrating these capabilities, the industry is transitioning into a new era characterized by digitalization, smart systems, low-carbon practices, and human-centric approaches. This technological evolution not only enhances the efficiency and precision of landscape planning and management but also aligns with broader goals of sustainability and urban resilience [2].

This study aims to address the pressing need for industry transformation by examining the role of intelligent technologies in empowering design processes and driving management innovation. It proposes a comprehensive innovation framework designed to provide systematic insights into the reform of landscape architecture design and management models. By leveraging advanced technologies, the framework seeks to bridge existing gaps in traditional practices, offering a structured approach to enhance ecological, operational, and social outcomes. This approach underscores the importance of integrating technological advancements with human-centric principles to create sustainable and resilient urban environments [3]. The study's findings are intended to serve as a valuable resource for practitioners and policymakers seeking to navigate the complexities of modern urban development while fostering innovation and sustainability in the field of landscape architecture.

2. Core Concepts and Intelligent Technology System

2.1. Definition of Core Concepts

The integration of intelligent technology into landscape architecture encompasses a comprehensive application of advanced systems such as sensing, computing, analysis, decision-making, and control technologies. These systems are employed across the entire lifecycle of landscape projects, including planning, design, construction, management, operation, maintenance, and service delivery. This innovative approach establishes a modern development framework characterized by measurable data, visualizable models, computable simulations, controllable management, and perceptible services. By leveraging these technologies, the primary objectives are to enhance the scientific accuracy of design processes, improve the precision of management practices, strengthen ecological stability, and prioritize user-centric service delivery. Furthermore, this methodology facilitates the creation of adaptive and sustainable landscapes that respond effectively to environmental and societal needs, ensuring long-term functionality and resilience [4].

2.2. Core Intelligent Technology System Supporting Landscape Architecture

Big Data and Cloud Computing play a pivotal role in landscape architecture by enabling the collection and integration of diverse data sources, such as topography, meteorological conditions, pedestrian flow, soil properties, vegetation distribution, and public sentiment. These data sets provide a robust foundation for informed planning and decision-making processes. Artificial Intelligence (AI) enhances on-site analysis by generating solutions, optimizing plant configurations, rendering visualizations, and improving route planning. Building Information Modeling (BIM) supports 3D visualization, precise quantity surveying, collaborative construction workflows, and comprehensive lifecycle management of projects. Geographic Information Systems (GIS) contribute to terrain analysis, hydrological assessments, landscape pattern evaluations, and ecological sensitivity studies, ensuring sustainable designs. The Internet of Things (IoT) facilitates real-time monitoring of critical environmental factors, including soil moisture, sunlight intensity, wind speed, water quality, seedling growth, and visitor traffic, enabling adaptive management strategies. Digital Twin Technology creates virtual

replicas of physical landscapes, allowing for real-time monitoring, simulation modeling, and intelligent decision-making [5, 6]. Virtual Reality, Augmented Reality, and Mixed Reality (VR/AR/MR) provide immersive demonstrations of solutions, enhance public engagement in design processes, and offer virtual park experiences. Smart control and automation systems integrate intelligent irrigation, advanced lighting solutions, automated waste sorting, smart security measures, and coordinated emergency responses, ensuring efficient and sustainable landscape management.

3. Practical Significance of Intelligent Technology Empowering Landscape Architecture

3.1. Enhancing the Scientific Rigor of Design and Reducing Reliance on Empirical Experience

Through the application of GIS ecological analysis and AI-driven site simulation, landscape architecture design achieves precise quantification of critical environmental factors such as ventilation, sunlight exposure, hydrological conditions, biodiversity, and pedestrian and thermal maps. This technological integration transforms the design process from one primarily based on subjective aesthetics to a robust, data-driven methodology [7]. By leveraging these advanced tools, designers can ensure that their decisions are informed by measurable and scientifically validated parameters, thereby enhancing the overall effectiveness and sustainability of their projects.

In traditional landscape architecture, the design process has often been dominated by the personal experience, artistic perception, and subjective judgment of designers. While this approach can yield visually appealing results, it frequently encounters limitations when addressing complex site conditions, ecological requirements, and the diverse needs of public spaces. The integration of intelligent technologies has revolutionized this field. For example, during the site planning phase, GIS technology enables the collection and analysis of high-precision data related to topography, soil types, and vegetation distribution. This foundational information equips designers with a comprehensive understanding of the site. Subsequently, AI facilitates the rapid simulation and comparison of multiple design options based on this data, predicting critical metrics such as ecological benefits, spatial efficiency, and user accessibility under various design strategies. This data-driven approach ensures that design solutions are not solely reliant on inspiration or intuition but are grounded in rigorous scientific analysis [8]. By incorporating these advanced methodologies, the accuracy and reliability of design decisions are significantly enhanced. Furthermore, this approach promotes a shift in landscape architecture toward a more scientific and rational paradigm, ensuring that projects are not only aesthetically pleasing but also environmentally sustainable and functionally effective in meeting the needs of diverse stakeholders.

3.2. Improve Construction Efficiency and Reduce Project Costs

Building Information Modeling (BIM) facilitates seamless multi-party collaboration, enabling effective collision detection and precise quantity calculations. This reduces rework and material waste while enhancing construction accuracy. Unmanned Aerial Vehicle (UAV) surveying technology plays a pivotal role by rapidly capturing three-dimensional terrain data, which is then used to generate high-precision digital elevation models. These models provide accurate spatial references for construction planning, effectively eliminating errors caused by terrain inaccuracies. Construction robots, designed for repetitive tasks such as seedling planting and paving, exhibit remarkable efficiency and stability. Their deployment significantly shortens project timelines, reduces labor costs, and alleviates physical strain on workers. Furthermore, intelligent supply chain management systems enhance operational efficiency by optimizing real-time monitoring and scheduling across material procurement, transportation, and inventory management. This ensures efficient resource allocation, minimizes material stockpiling and waste, and controls project costs at the source. The integration of these advanced technologies creates a comprehensive efficiency enhancement chain that spans design optimization, construction execution, and resource management. This holistic approach

not only drives substantial cost reductions and efficiency improvements in landscape architecture projects but also ensures that quality standards are consistently maintained throughout the project lifecycle [5].

3.3. Achieving Precision Management to Promote Refined Urban Governance

The Internet of Things (IoT) and digital twin technology facilitate the comprehensive management of green spaces by integrating various data streams, such as seedling growth, facility conditions, ecological metrics, and visitor activity. This integration provides real-time visibility, enabling rapid identification and resolution of issues. By leveraging these technologies, urban ecological systems become more controllable, supporting low-carbon development and "dual carbon" objectives. Intelligent monitoring systems track key environmental indicators, including carbon sink performance, water runoff, air quality, and vegetation health. These capabilities allow for the calculation, traceability, and optimization of ecological benefits, ensuring that urban green spaces contribute effectively to sustainable development goals.

Enhancing public service levels within urban landscapes is essential for fostering a stronger sense of fulfillment among citizens. Advanced technologies, such as intelligent navigation systems, smart lighting, and contactless parking solutions, improve the overall accessibility and usability of these spaces. Emergency alert systems and barrier-free services further enhance safety and inclusivity, ensuring that all individuals, regardless of physical ability, can enjoy these environments. These innovations collectively create urban landscapes that are not only safer but also more comfortable and convenient for diverse user groups, thereby elevating the overall quality of life in urban areas.

The smart park management platform, developed through the integration of multi-source data, dynamically adjusts operational parameters to enhance visitor experiences. For example, it modifies security patrol schedules and facility operating hours based on real-time visitor traffic patterns. During peak holiday periods, the platform automatically deploys additional temporary seating and extends the operating hours of public restrooms to accommodate increased demand. To address the needs of specific groups, voice-activated intelligent guidance systems provide real-time assistance, such as directions to barrier-free pathways and baby care facilities. By analyzing visitor behavior and preferences through big data, the platform optimizes the design and functionality of park spaces [9]. For instance, interactive educational installations can be strategically placed in children's play areas, while additional vegetation can be planted to increase shade in senior rest zones. These targeted improvements ensure that park services align more closely with the diverse needs of the public, significantly enhancing visitor satisfaction and overall enjoyment of urban green spaces.

4. Issues in Traditional Landscape Architecture Design and Management

The design level of traditional landscape architecture often suffers from insufficient quantification and weak interdisciplinary synergy. Site analysis predominantly relies on subjective experience, which poses challenges in accurately quantifying ecological benefits. Furthermore, data integration across multiple disciplines, such as landscape architecture, architecture, municipal engineering, and water resources, remains fragmented [10]. This fragmentation leads to repeated modifications of design schemes, significantly reducing efficiency and increasing project timelines. The lack of standardized methodologies for data synthesis further exacerbates these inefficiencies, making it difficult to achieve cohesive and sustainable design outcomes.

At the construction level, traditional practices are hindered by coarse control mechanisms and frequent implementation deviations. Two-dimensional drawings often fail to adequately represent complex design intentions, resulting in high communication costs during on-site construction. Arbitrary changes made during the construction phase, coupled with lax material control, frequently lead to substantial discrepancies between the original design and the final implementation. These deviations not only compromise the aesthetic and functional integrity of the project but also increase the likelihood of

resource wastage and long-term maintenance challenges. Enhanced visualization tools and stricter material oversight could mitigate these issues, ensuring closer alignment between design and execution.

Management practices in traditional landscape architecture are plagued by data gaps and delayed decision-making processes. Baseline data for green spaces are often unclear, with seedling records either incomplete or entirely absent. Maintenance operations rely heavily on manual labor, which slows problem detection and resolution, leading to higher management costs. At the operations and maintenance level, resource inefficiencies and ecological risks are prevalent. Irrigation and lighting systems depend on manual experience rather than automated systems, resulting in significant water and electricity wastage. Additionally, early warning mechanisms for issues such as seedling pests, soil degradation, and water eutrophication are lacking, increasing ecological vulnerability. On the service level, traditional designs fail to prioritize human-centric features, resulting in poor user experiences. The absence of intelligent navigation systems, interactive features, and emergency response mechanisms limits the ability of parks to meet the evolving demands of modern citizens for smart and user-friendly environments. Incorporating advanced technologies and data-driven solutions could address these shortcomings, fostering more sustainable and user-focused landscapes [11].

5. Innovation in Landscape Architecture Design Based on Intelligent Technology

5.1. Data-Driven Planning and Design Innovation

Utilizing GIS combined with big data analytics, terrain analysis, slope gradient and aspect evaluation, hydrological runoff assessments, ecological sensitivity studies, and population activity heat map analyses are conducted to inform the planning process. These tools enable the scientific determination of functional layouts, road network structures, open spaces, and ecological buffer zones [12]. This approach ensures "precise site selection and rational planning," optimizing land use while maintaining ecological balance. By leveraging these advanced technologies, designers can create more sustainable and efficient landscapes that align with both environmental and human needs.

By integrating diverse data sources, such as meteorological data, soil composition data, and vegetation coverage information, a comprehensive and dynamic database is established to support planning and design processes. Advanced data mining techniques are employed to analyze historical planning cases and user behavior patterns, uncovering valuable insights that inform current projects [11]. Data visualization tools transform complex datasets into intuitive charts and maps, enhancing designers' ability to interpret and apply the information effectively. Furthermore, a robust data update mechanism ensures that the database remains current and accurate, allowing for real-time adjustments in planning and design. This dynamic approach not only improves decision-making but also fosters innovation by enabling adaptive strategies that respond to evolving environmental and societal needs.

5.2. AI-Assisted Solution Generation and Optimization Innovation

AI systems are capable of autonomously generating floor plans, plant configurations, and vertical designs by analyzing site-specific conditions, aesthetic requirements, and plant compatibility. By comparing multiple solutions, these systems identify optimal designs that balance ecological benefits, project costs, and utilization efficiency, thereby significantly improving both the efficiency and quality of design processes. This approach minimizes manual effort and accelerates project timelines, ensuring that the final outcomes are both innovative and scientifically grounded.

AI employs advanced deep learning algorithms to extract features and discern patterns from extensive datasets of exemplary design cases. This enables the rapid creation of preliminary design proposals tailored to specific site conditions, such as topography, climate characteristics, and soil types, as well as design preferences, including classical gardens, modern minimalism, or natural rustic aesthetics. During plant configuration, AI integrates data on growth habits, ecological functions, ornamental traits,

and environmental compatibility from botanical databases to intelligently recommend plant species, quantities, and combinations. It also simulates seasonal landscape effects to ensure year-round visual appeal. For vertical design, AI analyzes original site topography data to generate optimized terrain modification suggestions, such as gentle slopes, terraces, or micro-landscapes, while considering drainage systems, visual aesthetics, and activity requirements. In the multi-option evaluation phase, AI constructs quantitative assessment models to analyze and score various proposals based on ecological benefits, such as carbon sequestration capacity, biodiversity enhancement, and soil erosion control; engineering costs, including materials, construction, and maintenance expenses; and operational efficiency, such as space utilization rates, accessibility, and user satisfaction. By selecting the most optimal solutions, this intelligent design optimization process reduces repetitive tasks, shortens development cycles, and transcends the limitations of human experience. It explores innovative possibilities grounded in scientific principles, thereby elevating the efficiency and quality standards of landscape architecture to new heights.

5.3. Innovative Integrated 3D Design with BIM+GIS Integration

Constructing a three-dimensional landscape model involves the integration of diverse datasets, including terrain, vegetation, water bodies, buildings, pipelines, and lighting, to enable comprehensive visual design. This model facilitates the simulation of various environmental and operational scenarios, such as seasonal landscape changes, day-night lighting effects, rainfall and flood processes, and crowd evacuation dynamics. By enabling these simulations, potential design issues can be identified early in the process, allowing for timely optimization and enhancing the overall feasibility and resilience of the design solution. Such an approach not only improves the accuracy of the design but also ensures that the final output aligns with practical and environmental considerations.

BIM technology, with its advanced parametric modeling and information integration capabilities, allows for the detailed assignment of attributes to landscape design elements. These attributes include plant species, specifications, quantities, paving materials, dimensions, and the styles and locations of small-scale features. This enables the construction of interconnected 3D models that are rich in detail and functionality. Concurrently, GIS technology excels in processing geospatial data, offering precise macro-level geographic information such as topography, soil types, hydrological conditions, and the characteristics of surrounding environments. The integration of these technologies transforms 3D landscape models from simple visual representations into "digital twins" that are enriched with both spatial and non-spatial data [11, 13]. During the design process, this integrated model supports multidimensional collaboration. For instance, architects can optimize building layouts using GIS-derived solar radiation analysis data, while landscape designers can simulate seasonal vegetation changes by leveraging BIM's plant growth parameters. This seamless interdisciplinary coordination enhances the efficiency and accuracy of the design process. Additionally, BIM+GIS integrated platforms enable the correlation of design outcomes with urban infrastructure and transportation network data. This ensures that landscape designs are systematically aligned with broader urban planning strategies, thereby enhancing the coherence and systematic nature of projects. Such integration not only improves the quality of individual designs but also contributes to the holistic development of urban environments.

5.4. Innovation in Ecological Quantitative Simulation Design

By leveraging intelligent software to simulate ecological functions such as heat island mitigation, rainwater storage, carbon sequestration capacity, noise attenuation, and ventilation corridors, landscape design transitions from a predominantly "aesthetics-oriented" approach to one that integrates "ecology-oriented" and "low-carbon-oriented" principles. This transformation allows ecological objectives to be quantified, enabling designers to create landscapes that are both visually appealing and environmentally sustainable. Advanced simulation tools provide the capability to model and predict

ecological outcomes with precision, ensuring that design decisions are informed by measurable data rather than subjective assessments. For instance, heat island mitigation simulations utilize microclimate modeling software like ENVI-met, which incorporates detailed parameters such as plant species, canopy width, leaf area index, thermal reflectivity, and heat capacity of paving materials, alongside water body area and distribution patterns. These inputs enable the system to calculate microclimate variables such as air temperature, relative humidity, mean radiometric temperature, and wind speed under various design scenarios. This facilitates the optimization of green space layouts and plant community compositions to maximize cooling effects during summer, leveraging mechanisms like vegetation transpiration, water evaporation, and shading structures. Similarly, rainwater retention simulations employ tools such as SWMM (Storm Water Management Model), which integrate structural parameters of sponge facilities—including sunken green spaces, grass swales, rain gardens, and permeable pavements—with local rainfall data. By analyzing factors like permeability coefficients, water storage depth, and catchment areas in conjunction with precipitation data, the system simulates surface runoff coefficients, infiltration rates, storage capacities, and stormwater discharge reduction rates under varying rainfall intensities. Comparative analyses of different sponge facility combinations allow designers to identify optimal configurations for effective stormwater management, reducing urban flooding risks during extreme rainfall events. Carbon sink simulations utilize software such as CITYgreen to analyze plant species, age, diameter at breast height (DBH), tree height, and growth environment data, combined with local climate conditions. This enables the calculation of annual carbon sequestration capacity and oxygen release rates for individual plants and entire green spaces. Additionally, the carbon footprint of landscape materials during production, transportation, and construction processes is considered, allowing for the selection of plants and materials that maximize carbon sequestration while minimizing emissions. Noise attenuation simulations employ acoustic modeling software like SoundPLAN to evaluate the propagation paths and attenuation patterns of major noise sources, such as traffic and industrial noise, under various landscape configurations. Parameters such as hedge width, height, density, and terrain undulations are analyzed to quantify the noise reduction effects of vegetation barriers, topographical barriers, and water body absorption. This supports the rational planning of sound-isolated green spaces and quiet recreational areas, enhancing acoustic environmental quality. Ventilation corridor simulations integrate computational fluid dynamics (CFD) technology to model air flow velocity, direction, and pressure distribution under different building layouts, vegetation configurations, and topographical conditions. By identifying ventilation bottlenecks and potential areas within sites, designers can construct effective ventilation corridors through open space design and directional vegetation placement, promoting fresh air circulation and pollutant dispersion to improve regional air quality. These ecological quantitative simulations empower designers to scientifically predict and precisely regulate ecological benefits during the conceptual phase [14, 15]. By transitioning from qualitative descriptions to measurable and optimizable ecological performance supported by data, landscape architecture achieves a higher standard of sustainability, combining aesthetic value with ecological service functions.

In the realm of heat island mitigation, microclimate modeling software such as ENVI-met plays a pivotal role by enabling detailed simulations based on plant configuration parameters, including species, canopy width, and leaf area index, as well as the thermal properties of paving materials and the spatial distribution of water bodies [14]. These inputs allow the system to calculate critical microclimate variables such as air temperature, relative humidity, mean radiometric temperature, and wind speed across various design scenarios. This quantitative evaluation of cooling effects—achieved through mechanisms like vegetation transpiration, water evaporation, and shading structures—guides the optimization of green space layouts and plant community compositions to enhance summer cooling efficiency. For rainwater retention, tools like SWMM (Storm Water Management Model) integrate structural parameters of sponge facilities, such as sunken

green spaces, grass swales, rain gardens, and permeable pavements, with local rainfall data. By analyzing permeability coefficients, water storage depth, catchment areas, and precipitation data, the system simulates surface runoff coefficients, infiltration rates, storage capacities, and stormwater discharge reduction rates under varying rainfall intensities. Comparative analysis of sponge facility combinations identifies optimal configurations for effective stormwater management, mitigating urban flooding risks during extreme rainfall events. Carbon sink simulations utilize professional software such as CITYgreen to analyze plant species, age, diameter at breast height (DBH), tree height, and growth environment data, combined with local climate conditions. This enables the calculation of annual carbon sequestration capacity and oxygen release rates for individual plants and entire green spaces. Furthermore, the carbon footprint of landscape materials during production, transportation, and construction processes is considered, allowing for the selection of plants and materials that maximize carbon sequestration while minimizing emissions. Noise attenuation simulations employ acoustic modeling software like SoundPLAN to analyze the propagation paths and attenuation patterns of major noise sources, such as traffic and industrial noise, under various landscape configurations. Parameters such as hedge width, height, density, and terrain undulations are evaluated to quantify the noise reduction effects of vegetation barriers, topographical barriers, and water body absorption. This facilitates the rational planning of sound-isolated green spaces and quiet recreational areas, improving acoustic environmental quality. Ventilation corridor simulations integrate computational fluid dynamics (CFD) technology to model air flow velocity, direction, and pressure distribution under different building layouts, vegetation configurations, and topographical conditions. By identifying ventilation bottlenecks and potential areas within sites, designers can construct effective ventilation corridors through open space design and directional vegetation placement, promoting fresh air circulation and pollutant dispersion to enhance regional air quality. These ecological quantitative simulations enable designers to scientifically predict and precisely regulate ecological benefits during the conceptual phase. By transitioning from qualitative descriptions to measurable and optimizable ecological performance supported by data, landscape architecture achieves a higher standard of sustainability, combining aesthetic value with ecological service functions.

6. Conclusion and Prospects

Intelligent technologies are fundamentally transforming the design logic, construction methodologies, management frameworks, and service philosophies within the landscape architecture industry, driving its comprehensive evolution from traditional extensive models to digital-intelligent systems, eco-friendly low-carbon practices, and human-centric service approaches. These advancements are reshaping the industry by integrating cutting-edge tools and methodologies that enhance the precision and efficiency of design and construction processes. Innovations in landscape design and management powered by smart technologies not only improve the scientific rigor of design, engineering efficiency, and operational precision, but also contribute significantly to strengthening ecological functions, enhancing public services, and supporting the development of smart cities. This transformation represents an inevitable pathway for achieving high-quality industry advancement, as it aligns with global trends toward sustainability and technological integration. Furthermore, the adoption of intelligent systems enables the industry to address complex challenges such as urbanization, climate change, and resource scarcity, thereby fostering a more resilient and adaptive approach to landscape architecture.

In the future, with the continuous advancement of large-scale models, digital twins, the Internet of Things, and artificial intelligence technologies, landscape architecture will further evolve into a new phase characterized by full-cycle intelligent management, comprehensive ecological quantification, widespread public participation, and low-carbon operations across all scenarios. This evolution will enable the creation of smart landscapes that serve as crucial platforms for urban ecological security, public services,

cultural experiences, and low-carbon development. These landscapes will provide core support for building livable, resilient, intelligent, green, and humanistic cities, addressing the growing demand for sustainable urban environments. To achieve this vision, the landscape architecture industry must proactively embrace intelligent technologies, fostering a culture of innovation and adaptability. This includes accelerating the updating of concepts, cultivating interdisciplinary talent, and pioneering new models of design and management. By leveraging these advancements, the industry can empower ecology, art, and daily life, creating landscapes that seamlessly integrate functionality, aesthetics, and sustainability. This approach will not only enhance the quality of urban living but also contribute to global efforts in combating climate change and promoting environmental stewardship, thereby forging a distinctive path of smart landscape architecture development tailored to the unique needs and characteristics of different regions.

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References

1. A. M. Ghazal, "Criteria for sustainable planting design applications in landscape architecture projects under arid conditions," *Engineering and Technology Journal*, vol. 37, no. 1, pp. 10–18, 2019.
2. S. Strom, K. Nathan, and J. Woland, *Site engineering for landscape architects*. John Wiley & Sons, 2013.
3. Y. Xing, W. Gan, and Q. Chen, "Artificial intelligence in landscape architecture: a survey," *International Journal of Machine Learning and Cybernetics*, vol. 16, no. 7, pp. 4685–4710, 2025.
4. B. Zhang, Y. Deng, and F. Luo, "Construction and Research on Employment of Landscape Architecture Courses in Colleges and Universities," *Curriculum and Teaching Methodology*, vol. 6, no. 5, pp. 8–12, 2023.
5. M. Ge, J. Kong, Q. Yang, M. Chen, and W. Wang, "Examine an Intelligence Education Framework of Landscape Architecture (EFLA) Based on Network Model of Technology in Landscape Architecture (NMTLA)," *Sustainability*, vol. 15, no. 14, p. 11277, 2023.
6. G. Liu, "Landscape architecture design and implementation based on intelligent monitoring sensing network," *Journal of Sensors*, vol. 2023, no. 1, p. 9188907, 2023.
7. J. Nassauer, Ed., *Placing nature: culture and landscape ecology*. Island Press, 2013.
8. S. T. Lovell and D. M. Johnston, "Creating multifunctional landscapes: how can the field of ecology inform the design of the landscape?," *Frontiers in Ecology and the Environment*, vol. 7, no. 4, pp. 212–220, 2009.
9. H. Shi, N. Li, and Y. Liu, "Intelligent analysis of landscape architecture based on digital technology under 5G network," *Journal of Intelligent & Fuzzy Systems*, vol. 45, no. 3, pp. 4415–4425, 2023.
10. J. D. Hunt, *Gardens and the picturesque: studies in the history of landscape architecture*. MIT Press, 1992.
11. W. Zhang, "Design of urban garden landscape visualization system based on GIS and remote sensing technology," *Computational Intelligence and Neuroscience*, vol. 2022, no. 1, p. 9592376, 2022.
12. Y. Li, H. Chen, P. Yu, and L. Yang, "A review of artificial intelligence in enhancing architectural design efficiency," *Applied Sciences*, vol. 15, no. 3, p. 1476, 2025.
13. M. Treib, "Must landscapes mean?: approaches to significance in recent landscape architecture," *Landscape Journal*, vol. 14, no. 1, pp. 46–62, 1995.
14. A. J. Felson and S. T. Pickett, "Designed experiments: new approaches to studying urban ecosystems," *Frontiers in Ecology and the Environment*, vol. 3, no. 10, pp. 549–556, 2005.
15. M. E. Deming and S. Swaffield, *Landscape architectural research: Inquiry, strategy, design*. John Wiley & Sons, 2011.

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