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The Collaborative Development of Landscape Design Technology Management and Maintenance in the Field of Landscape Architecture

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Abstract: In the field of landscape architecture, the coordinated development of landscape design technology management and maintenance is of great significance to real estate engineering. It is necessary to establish a technical management system, create a collaborative control mechanism, build a standard framework, formulate multi-disciplinary collaborative standards, and apply technologies such as IoT monitoring. Simultaneously, real estate enterprises must undertake project management organization restructuring and supplier collaborative management, construct economic evaluation models and ecological benefit assessment methods. They should also distill key points, deepen technical applications, and cultivate interdisciplinary talents.

Keywords: Landscape design technology management; Maintenance; Collaborative development

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1. Introduction

In 2021, the Ministry of Housing and Urban-Rural Development issued the "Guiding Opinions on Promoting the Collaborative Development of Intelligent Construction and Building Industrialization," aiming to drive the intelligent development of the construction industry. In the field of landscape architecture, the collaborative development of landscape design technology management and maintenance is crucial. This involves not only the technical control from design concepts to construction details but also the coordinated operation of all stages. Close coordination is required across various aspects, from the application of modern technical means and the establishment of collaborative control mechanisms to the construction of a standard framework for whole-process technical management. Policy guidance provides strong support for its development, prompting the industry to continuously explore innovations to optimize resource allocation and enhance the overall quality and value of

landscape architecture projects.

2. Theoretical basis of landscape design and technology management

2.1. The connotation of landscape design technology management

Landscape design technology management involves the planning, organization, coordination, and control of the technical aspects within the landscape design process in the field of landscape architecture [1]. Its scope spans from the technical translation of design concepts to the technical control of specific construction details. It plays a vital role in real estate engineering projects. From the perspective of design normative documents, these documents summarize and refine the principles and standards of landscape design, ensuring its scientific nature, rationality, and sustainability. Construction standards, developed based on these design normative documents, serve as operational guidelines for accurately realizing the design intent. Landscape design technology management must ensure a close connection between the two, enabling design concepts to be realized through construction techniques that comply with standards. It concerns not only the aesthetics of the landscape but also its functionality, safety, and durability, achieving a high-quality transformation from design blueprint to actual landscape, and ensuring that landscape architecture projects within real estate engineering achieve the expected outcomes.

2.2. Characteristics of collaborative needs in real estate engineering

In the field of landscape architecture, real estate engineering involves multiple stages such as landscape design, technology management, and maintenance, among which there exist significant collaborative needs. Landscape design serves as the blueprint for the real estate landscape, with its concepts and details determining the direction of subsequent construction and maintenance. Technology management provides support for the implementation of the design and the feasibility of maintenance. However, a lack of collaboration among these stages can easily lead to issues such as disconnection between design and construction, excessively high maintenance costs, or poor results. For instance, unreasonable designs may increase construction difficulty and costs and be detrimental to later maintenance. Therefore, real estate engineering requires the collaborative development of landscape design, technology management, and maintenance. Through close communication and cooperation among all stages, it ensures technical feasibility of the design, guaranteed construction quality, and efficient later maintenance, thereby optimizing resource allocation and improving the overall quality of the real estate landscape [2].

3. Practice of landscape technology management in real estate engineering

3.1. Technology management system in the design stage

In the landscape design stage of real estate engineering, it is of great significance to build a comprehensive technology management system using modern technical means. Taking BIM technology as an example, its assistance in design can enable the visual simulation of landscape schemes. Within the management process, starting from the initial conceptualization of the scheme, designers can use BIM technology to create 3D models, identifying and adjusting issues related to spatial layout, scale, proportion, etc., in advance, thus avoiding changes and rework during the construction phase. Parametric plant community configuration involves establishing a plant database, precisely screening suitable plants based on site conditions such as light and soil, and setting parameters for plant spacing, layers, etc., to optimize the plant community configuration scheme. These modern technical

means not only improve the quality of landscape scheme design but also make the management process more scientific and efficient, laying a solid foundation for subsequent construction and maintenance, and promoting the collaborative development of landscape design technology management and maintenance [3].

3.2. Collaborative control mechanism in the construction process

In the landscape construction process of real estate engineering, establishing an effective collaborative control mechanism is crucial. The design team should communicate closely with the construction team to ensure the accurate transmission and realization of the design intent. From the perspective of material selection, designers need to clearly communicate the specifications and quality requirements for various materials such as plants and stones to the construction personnel, who, based on practical feasibility, provide feedback, jointly determining the optimal solution. In terms of schedule control, both parties should develop detailed construction plans, reasonably arranging work sequences according to the design priorities and construction complexity, while closely monitoring external factors like weather and making flexible adjustments. Regarding quality supervision, a joint inspection mechanism should be established. Designers, leveraging their professional knowledge from the perspective of landscape effect, and construction personnel, from the standpoint of craft standards, strictly inspect each work process together, identifying and resolving issues promptly to ensure the quality of the landscape project and achieve the collaborative advancement of design and construction [4].

4. Construction of a collaborative development mechanism

4.1. Standardization system for technology management

4.1.1. Whole life cycle control standards

Establishing a standard framework for landscape engineering technology management covering the entire process of scheme design-construction-operation and maintenance is key to achieving the collaborative development of landscape design technology management and maintenance in the field of landscape architecture. In the scheme design stage, clear design indicators, norms, and parameters are defined to ensure the design meets ecological, aesthetic, and functional requirements. During the construction process, the standard framework is used to strictly control material selection and craft operations, ensuring project quality [5]. In the operation and maintenance stage, detailed standards for plant maintenance and facility upkeep are formulated to ensure the long-term stable operation of the landscape. Through whole life cycle control standards, the stages of design, construction, and maintenance are closely linked, forming an organic whole, enabling landscape design technology management and maintenance to cooperate and promote each other under unified standards, enhancing the overall quality and value of landscape architecture projects, and achieving the goal of collaborative development.

4.1.2. Multi-disciplinary collaborative standards

In the field of landscape architecture, to achieve the collaborative development of landscape design technology management and maintenance, it is necessary to formulate multi-disciplinary collaborative standards for landscape design, civil engineering, municipal works, etc. For collaboration between landscape design and civil engineering, during project application and approval, detailed communication should be conducted regarding site planning and building layout to ensure the integration of landscape and architectural style. During concealed acceptance, the civil engineering discipline should promptly provide relevant data from foundation construction to landscape design for subsequent layout. For collaboration between landscape design and municipal engineering, during

the project application stage, they need to jointly discuss the layout of water and electricity pipelines to ensure the landscape's water and electricity needs. During concealed acceptance, the municipal engineering discipline should inform landscape design about the installation of underground pipelines to avoid damage during landscape construction. By clarifying the collaborative work norms for various disciplines in key links such as project application and concealed acceptance, the overall quality of landscape architecture projects is enhanced, promoting the collaborative development of landscape design technology management and maintenance [6].

4.2. Integration path of intelligent maintenance technology

4.2.1. Application of IoT monitoring systems

In the field of landscape architecture, IoT monitoring systems play an important role in the collaborative development of landscape design technology management and maintenance. By researching the integrated application model of intelligent sensing equipment in maintenance scenarios such as plant health monitoring and irrigation system regulation, the intelligence and refinement of landscape maintenance can be achieved. Using various sensors, parameters of the plant growth environment, such as soil moisture, nutrient content, and light intensity, are collected in real-time, and the data is transmitted to a management platform via IoT technology [7]. Based on the data analysis results, the platform precisely regulates the irrigation system, providing a suitable environment for plant growth. Simultaneously, plant health issues are detected early, enabling warnings, so that landscape managers can quickly take targeted maintenance measures. The application of this IoT monitoring system effectively integrates landscape design technology and maintenance work, promoting their collaborative development and enhancing the overall quality and management efficiency of the landscape.

4.2.2. Big data decision support platform

Constructing a decision support system architecture based on landscape facility operation and maintenance data is crucial for the collaborative development of landscape design technology management and maintenance in the field of landscape architecture. This architecture integrates data collected from the daily operation and maintenance of landscape facilities, covering information such as facility usage frequency, damage conditions, and maintenance records [8]. Leveraging this data, the system can conduct in-depth analysis, providing strong support for the post-evaluation of real estate projects. Through this platform, the rationality of landscape design in practical use can be accurately assessed, such as identifying which landscape facilities frequently break down or have low usage rates due to unreasonable design, while also judging the effectiveness of maintenance strategies, such as whether the maintenance frequency in specific areas is appropriate. These evaluation results are fed back to the landscape design and maintenance stages, helping to optimize design schemes and adjust maintenance measures, realizing the collaborative development of landscape design technology management and maintenance, and improving the overall quality and benefits of landscape architecture projects.

5. Implementation strategies for collaborative development

5.1. Implementation path for real estate development enterprises

5.1.1. Project management organization restructuring

In the collaborative development of landscape design technology management and maintenance in the field of landscape architecture, real estate development enterprises should establish a cross-departmental landscape engineering dedicated team in terms of project management organization restructuring. This team needs to be

fully responsible for the control of key nodes such as design disclosure and final inspection. During the design disclosure stage, the dedicated team must ensure that the design team's intent is accurately communicated to the construction and maintenance teams, avoiding obstacles in subsequent work due to misunderstandings. During the final inspection stage, quality is strictly controlled, with detailed assessment from the implementation of the design concept to the initial presentation of maintenance effects. Through the establishment and effective operation of such cross-departmental teams, departmental barriers are broken down, communication and collaboration among all stages are strengthened, landscape design technology management and maintenance are closely integrated, collaborative development is achieved, and a strong guarantee is provided for the landscape quality of real estate projects [9].

5.1.2. Supplier collaborative management

In the field of landscape architecture, for real estate development enterprises to achieve the collaborative development of landscape design technology management and maintenance, supplier collaborative management is crucial. Technical access standards for landscape material suppliers should be formulated, strictly defining technical parameters such as the quality and performance of materials provided by suppliers to ensure they meet the technical requirements of landscape design, guaranteeing the quality of landscape construction from the source. Simultaneously, a whole-process assessment indicator system for maintenance service providers should be established, covering all stages from the basic maintenance work after the initial completion of the landscape to the long-term landscape maintenance effects [10]. Assessment content includes plant survival rate, landscape cleanliness, facility integrity rate, etc. Through this standard and system, suppliers and maintenance service providers are prompted to closely collaborate with landscape design technology management, enhancing the overall landscape quality, achieving the goal of collaborative development between design and maintenance, and creating high-quality landscape environments for real estate projects.

5.2. Innovative application of technology management tools

5.2.1. Application of digital twin technology

In the field of landscape architecture, digital twin technology can provide strong support for the collaborative development of landscape design technology management and maintenance. In real estate development projects, real-time monitoring and simulation prediction are achieved by constructing digital twin models of landscape facilities. Using sensors and other equipment to collect physical data such as the location, structure, and materials of actual landscape facilities, which are then mapped into a virtual digital model, enables real-time monitoring of the status of landscape facilities and timely identification of potential problems. Digital twin technology is used to simulate and predict different environmental changes and usage scenarios, such as simulating the impact of different seasonal climates on plant growth, or the wear and tear on landscape facilities from large pedestrian flow activities, thereby allowing for the advanced assignment of maintenance plans and design optimization strategies. This provides data support and decision-making basis for the collaborative development of landscape design technology management and maintenance, enhancing the overall quality and sustainability of the landscape.

5.2.2. Blockchain traceability system

In the field of landscape architecture, designing a traceability mechanism for the landscape material supply chain based on blockchain is of great significance for the collaborative development of landscape design technology

management and maintenance. Through this mechanism, starting from the procurement source of landscape materials, information from each link, such as the material's origin, supplier, transportation process, and storage time, is recorded on the blockchain in an encrypted form. This not only ensures the authenticity and immutability of material information, facilitating design and maintenance personnel to access accurate data at any time to assess the long-term impact of material quality on the landscape, but also allows for rapid identification of the problematic link in case of quality issues, enabling timely countermeasures. The blockchain-based traceability mechanism effectively guarantees the quality of landscape materials, promotes close collaboration between landscape design technology management and maintenance, and contributes to the healthy development of the landscape architecture field.

5.3. Collaborative benefit evaluation system

5.3.1. Economic evaluation indicators

In the field of landscape architecture, constructing an economic evaluation model is a key link to achieving the collaborative development of landscape design technology management and maintenance. The landscape maintenance cost saving rate is an important indicator, reflecting the extent to which maintenance costs can be reduced through scientific and reasonable design technology management during the maintenance process. For example, optimizing plant configuration can reduce maintenance workloads such as irrigation and pruning, thereby improving the cost saving rate. The asset appreciation rate should also not be overlooked. High-quality collaborative landscape design and maintenance can enhance the value of surrounding real estate and other assets. For instance, well-designed and well-maintained urban parks can lead to rising property prices in the surrounding area. By comprehensively considering dimensions such as the landscape maintenance cost saving rate and asset appreciation rate, a comprehensive economic evaluation model is formed, providing a quantitative basis for the collaborative development of landscape design technology management and maintenance, and promoting effective resource allocation and sustainable industry development.

5.3.2. Ecological benefit assessment methods

In the field of landscape architecture, establishing ecological benefit assessment methods is crucial for achieving the collaborative development of landscape design technology management and maintenance. A carbon sink efficiency calculation system can be constructed to measure the ability of landscape green spaces to absorb and fix carbon dioxide. By accurately measuring parameters such as plant biomass and growth rate, and combining them with relevant models, the carbon sequestration of different plants and different areas of landscape green spaces can be calculated to assess their contribution to mitigating the greenhouse effect. Simultaneously, a biodiversity index assessment method can be established, investigating and recording the plant species, quantity, distribution, and animal habitat situation within the landscape, using professional formulas to calculate the biodiversity index, and understanding the richness and stability of the ecosystem. These quantitative assessment method systems can effectively reflect the ecological benefits generated under the collaborative effect of landscape design and maintenance, providing a scientific basis for further optimizing collaborative development strategies.

6. Conclusion

In the field of landscape architecture, the collaborative development of landscape design technology management and maintenance is crucial in real estate engineering projects. Distilling key implementation points provides

practical guidance for their collaborative implementation, ensuring that landscape design concepts can be realized through scientific management and that landscape effects can be maintained long-term with effective maintenance measures. The deepened application of intelligent construction technologies will inject new vitality into collaborative development, using advanced technology to enhance design accuracy, management efficiency, and maintenance quality. The cultivation of interdisciplinary talents fundamentally addresses the current shortage of talent in the industry, enabling practitioners to possess knowledge of design, technology management, and maintenance, providing solid human support for collaborative development. In the future, we should continue to focus on these directions, constantly explore and innovate, promote the collaborative development of landscape design technology management and maintenance in the field of landscape architecture to new heights, and create more high-quality landscape projects.

Disclosure statement

The author declares no conflict of interest.

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