Design Thinking Empowering Enterprise Technological Innovation: Research on Direction Selection and Efficiency Improvement

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Abstract

Against the backdrop of urban renewal and the improvement of human settlement environmental quality, outdoor environmental design enterprises are confronted with practical dilemmas including ambiguous innovation directions, low project R&D efficiency, and disconnection between user demands and technical implementation. Centered on human orientation, design thinking provides methodological support for technological innovation of environmental design enterprises through an iterative closed loop of empathy, definition, ideation, prototyping and testing. Taking the outdoor environmental design industry as the research object, this paper analyzes the internal logic of design thinking applied in enterprise technological innovation, identifies pain points of environmental design enterprises in judging innovation directions and project R&D efficiency, constructs a mechanism for innovation direction selection and an optimization path for R&D efficiency based on design thinking, and conducts verification with practical cases of domestic landscape design enterprises. The research reveals that design thinking enables outdoor environmental design enterprises to identify real user demands, optimize technological innovation tracks, shorten scheme iteration cycles and reduce trial-and-error costs of innovation. It achieves two-way synergy between technological innovation and the on-site implementation of outdoor spaces, and can offer references for the technological upgrading of similar environmental design enterprises.

Keywords

Design thinking, outdoor environmental design, enterprise technological innovation, direction selection, R&D efficiency, Landscape Architecture.

1. Introduction

China's outdoor environmental design industry is undergoing transformation and upgrading. Projects such as urban parks, community landscapes, waterfront spaces and campus outdoor sites raise higher requirements for ecological technologies, smart landscapes, low-carbon materials and iterable spatial schemes. Many environmental design enterprises are trapped in innovation dilemmas. First, innovation direction selection is blind: enterprises simply equate technological innovation with the stacking of new materials and new software while ignoring the real demands of site users, making innovative outcomes difficult to implement. Second, R&D efficiency is insufficient: design workflows follow a linear pattern, schemes require repeated revisions, cross-disciplinary collaboration incurs high costs, and the transformation cycle of innovative results is lengthy.

As an innovation methodology for tackling complex problems, design thinking breaks the limitation of traditional engineering design that focuses merely on technical indicators, and emphasizes iterative innovation starting from end users' needs. Current domestic studies mostly focus on the application of design thinking in product and service design.

[1,2]Systematic research on how outdoor environmental design enterprises can adopt design thinking to select innovation tracks and improve project R&D efficiency remains relatively scarce. Based on the practice of outdoor environmental design enterprises, this paper investigates the implementation path for design thinking to empower enterprise technological innovation, and addresses two practical problems: lost innovation orientation and low R&D efficiency.

2. Theoretical Foundation

2.1. Core Connotation of Design Thinking

Design Thinking is a human-centered innovation methodology. Its classic Double Diamond Model consists of four phases: discover, define, develop and deliver. Its core lies in empathizing with users, reframing problems, diverging creative ideas, and iterating via prototyping and testing, so as to integrate human needs, technical feasibility and commercial viability (Taylor et al.). For outdoor environmental design enterprises, design thinking is not merely a creative tool for design schemes, but also an innovation management tool at the corporate level. It can be used to judge innovation directions for corporate strategy and optimize project R&D workflows.

2.2. Connotation of Technological Innovation in Outdoor Environmental Design Enterprises

Technological innovation of outdoor environmental design enterprises is not confined to hardware technologies and covers three dimensions. ① Technical dimension: low-carbon landscape materials, ecological technologies for rain gardens, generative digital design, smart outdoor facilities, etc. ② Design methodology dimension: site demand investigation methods and multi-stakeholder collaborative design workflows. ③ Outcome transformation dimension: translating innovative technologies into deliverable projects of parks, streets and community outdoor spaces. The core of enterprise technological innovation lies not only in selecting proper innovation directions but also in improving the transformation efficiency from creative concepts to on-site delivery.[3]

3. Existing Problems in Technological Innovation of Outdoor Environmental Design Enterprises

3.1. Biased Selection of Innovation Directions and Disconnection between Demands and Technologies

When carrying out technological innovation, most environmental design enterprises prioritize industry hotspots and pursue cutting-edge technologies without systematic evaluation of real demands from site users, clients and community residents. Some enterprises blindly introduce digital landscape and new ecological technologies that fail to match site conditions and user habits. Consequently, the innovative outcomes are “technologically advanced yet impractical for delivery”. Innovation investment hardly generates practical value and innovation directions deviate from actual needs.

3.2. Rigid R&D Workflows and Low Efficiency of Innovation Iteration

Traditional workflows of outdoor environmental design are mostly linear: demand receipt, scheme drafting, revision and drawing output, lacking user feedback and prototyping tests. Schemes are frequently reworked, and cross-disciplinary communication (among landscape, ecology, civil engineering and operation & maintenance teams) is costly. Innovative ideas lack small-scale validation; defects are only detected in the construction phase, leading to waste of time and cost and low overall efficiency of R&D transformation.

3.3. Insufficient Multi-stakeholder Collaboration and Difficulty in Integrating Innovation Resources

Outdoor environmental projects involve multiple parties including clients, residents, constructors and operation & maintenance organizations. Internal departments of enterprises (design, technology and marketing) operate in silos. The multi-party empathic research mechanism highlighted by design thinking has not been put into practice. Enterprises struggle to incorporate demands from diverse stakeholders into innovation decision-making, which further hinders precise positioning of innovation directions.

4. Construction of Enterprise Technological Innovation Path based on Design Thinking

Centered on two goals - direction selection and efficiency improvement, and combined with the Double Diamond Model, this section establishes an innovation implementation path adapted to outdoor environmental design enterprises.

4.1. Design-thinking Driven Mechanism for Innovation Direction Selection

(1) Empathic Research Phase: Exploring Real Innovation Demands Prior to technological innovation, enterprises should move beyond a pure technical perspective and conduct multi-dimensional empathic research. Interviews, site observations and questionnaire surveys are carried out targeting end users (community residents, park visitors), clients, constructors and operation & maintenance teams. Existing pain points of outdoor spaces are identified, such as insufficient rest nodes in outdoor spaces of old communities, rainwater logging, and poor accessibility for the elderly and children. Real site problems are taken as the starting point of innovation to avoid simply chasing technological hotspots.

(2) Problem Definition Phase: Screening Innovation Tracks Information collected from surveys is summarized and refined to distinguish “pseudo-demands” from genuine pain points and reframe innovation problems. A three-dimensional evaluation matrix covering demand, technology and commercial viability is built to score alternative innovation directions: ① value of user demands; ② implementability in outdoor projects; ③ corporate conditions in technology, cost and market. Technological innovation directions matching corporate resources and site pain points are selected, such as age-friendly outdoor landscape technologies for communities, low-cost ecological technologies for sponge cities, and auxiliary design tools for generative landscape, so as to finalize innovation decisions.

4.2. Design-thinking Oriented Strategies for Improving R&D Efficiency

(1) Establish Iterative R&D Workflows to Replace Traditional Linear Design Prototyping tests are introduced into project R&D of outdoor environmental design enterprises. For innovative technologies and schemes, small-scale site prototypes and digital simulation models are developed first for small-scale user testing. Feedback is collected to support rapid iteration and revision. Multiple rounds of verification are completed before formal construction, reducing large-scale rework in later stages and shortening R&D cycles.

(2) Build a Cross-department Collaborative Innovation Mechanism Barriers between design, technology and marketing departments are removed, and cross-functional innovation teams are formed to integrate user research, ideation and technical testing into teamwork. Ecological engineers and constructors are involved in conceptualization at the early stage of outdoor environmental projects to predict delivery risks in advance and reduce communication costs across disciplines.

(3) Construct a Feedback Closed Loop for Innovative Outcomes User feedback is continuously collected after project delivery. Site operation data and user evaluations are fed back into the

corporate innovation database, forming a closed loop of "research – ideation – prototyping – delivery – feedback – re-innovation" to continuously optimize corporate innovation directions.

5. Case Study

This paper takes a regional outdoor environmental design enterprise in China as a case. Previously, the enterprise suffered from vague innovation directions. It introduced digital landscape technologies blindly yet received poor feedback from delivered projects with high revision rates. The enterprise adopted design thinking to reform internal innovation activities:

Innovation direction screening: Through empathic research on local old residential districts and urban parks, two core pain points were identified: age-friendly outdoor spaces in communities and low-cost sponge landscapes. Some high-cost and hard-to-deliver cutting-edge technological tracks were abandoned, and priority innovation directions were determined.

Workflow optimization: A prototyping testing mechanism was established. At the preliminary stage of community landscape projects, small-scale prototypes of outdoor nodes were produced, and residents were invited to participate in testing and feedback to optimize schemes. Cross-disciplinary teams were organized where designers, ecologists and constructors jointly participated in early conceptualization.

Implementation effects: The matching degree of innovative projects for on-site delivery improved significantly. Scheme rework rates declined and R&D cycles were shortened. Innovative technological outcomes were effectively transformed into delivered outdoor projects in communities and parks, realizing integration of technological innovation and practice.

The case verifies that design thinking helps outdoor environmental design enterprises rationally select innovation directions, optimize R&D workflows and effectively improve the efficiency of corporate technological innovation.

6. Conclusion and Prospect

Based on the outdoor environmental design industry, this paper explores how design thinking empowers technological innovation of environmental design enterprises. The study demonstrates that starting from human-centered demands, design thinking helps outdoor environmental design enterprises address the practical challenges of blind innovation direction selection and low efficiency of innovation iteration. Innovation tracks can be screened via empathic research and problem definition. Iterative prototyping tests, cross-department collaboration and feedback closed loops can improve the transformation efficiency of corporate R&D and realize mutual empowerment between technological innovation and on-site outdoor space implementation.

This research has limitations with a limited number of case samples. Future studies can expand sample sizes and further investigate differentiated implementation strategies for outdoor environmental design enterprises of various scales. Under the background of urban renewal and the "Dual Carbon" goals, deep integration of design thinking with digital and ecological technologies will become an important development trend for technological innovation in outdoor environmental design enterprises.

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