

Sensory and Regenerative Design in SMEs: Strategies for Environmental Restoration and Experiential Engagement

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ABSTRACT

This study examines how small and medium enterprises (SMEs) can integrate sensory design with regenerative principles in retail and exhibition interiors to advance environmental restoration and experiential engagement across interconnected systems. Using an exploratory, literature-based synthesis of research and practice, it analyzes how multisensory cues (sight, sound, smell, touch, taste) shape affective and cognitive responses and how these responses can be orchestrated with ecological strategies to improve customer experience and employee well-being. The contribution is a set of actionable guidelines for cost-constrained SMEs that align physical–digital environments with organizational routines, lightweight technologies, and social–ecological objectives. Emphases include biophilic integration, circular and low-toxicity materials, calibrated soundscapes and ambient cues, modularity and reuse, and community participation. Reported effects suggest that multisensory, regenerative interventions deliver measurable value while reducing environmental impact, positioning SMEs as capable coordinators of coherent, system-level design.

Keywords: Regenerative design, Sensory design, Small and medium enterprises (SMEs), Sociotechnical systems integration, Phygital retail environments

INTRODUCTION

Small and medium enterprises (SMEs) operate at the interface of local economies and everyday environments, yet the simultaneous pursuit of ecological restoration and experiential engagement in SME interiors remains uneven. In this article, ecological restoration denotes design and operational choices that repair and enhance local socio-ecological conditions at the scale of the interior—closing material loops with low-toxicity, bio-based, or reclaimed finishes; improving indoor environmental quality (air, light, acoustics, micro-climate); and aligning procurement and maintenance with place-based stewardship—thus advancing a net-positive trajectory rather than mere harm reduction (Lyle, 1994; Capra, 1996; McDonough & Braungart, 2002; Reed, 2007; Mang & Reed, 2012).

In parallel, *experiential engagement* refers to affective and cognitive responses—attention, emotion, memory, decision-making—elicited by multisensory orchestration across vision, sound, smell, touch, and thermality, and by embodied interaction in space (Merleau-Ponty, 1945; Malnar &

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Vodvarka, 2004; Norman, 2004; Pallasmaa, 2005). These trajectories converge in interiors that act as active agents within living systems, where circular, place-attuned choices co-evolve with curated atmospheres to support human well-being and environmental performance (Erwine, 2017; Berto, 2005; World Green Building Council, 2014). Empirically and in industry reporting, healthy, daylighted, low-toxicity environments are associated with improved well-being and productivity, while organizations that excel at customer experience—often operationalized through sensory and service orchestration—outperform their markets (Berto, 2005; World Green Building Council, 2014; Bain & Company, 2015; Harvard Business Review, 2014).

At the same time, SMEs frequently face constrained capital, lean staffing, and regulatory frictions that depress adoption of both circular practices and multisensory methods, especially in material-intensive sectors (OECD, 2024). Against this backdrop, the study asks how sensory design and regenerative principles can be integrated in SME built environments—particularly retail and exhibition spaces—to coordinate ecological restoration with experiential engagement. Using an exploratory, literature-based method, it synthesizes scholarship in regenerative design and systems theory (Lyle, 1994; McDonough & Braungart, 2002; Capra, 1996; Reed, 2007; Mang & Reed, 2012) with the sensory/phenomenological canon (Merleau-Ponty, 1945; Malnar & Vodvarka, 2004; Norman, 2004; Pallasmaa, 2005) and practice-based evidence from case studies, mapping mechanisms that link multisensory cues to experiential outcomes and identifying strategies compatible with SME constraints (modularity, reuse, low-toxicity materials, local sourcing, lightweight sensing). The output is a set of practical, scalable guidelines that align physical–digital touchpoints with organizational routines and social–ecological objectives, offering SMEs a systems-oriented pathway to deliver measurable environmental improvements and richer, more memorable user experiences.

To support clarity and readability—particularly for readers outside environmental engineering or UX domains—the article adopts a concise set of abbreviations used throughout the text. The following list, presented at the beginning, standardizes frequent technical and operational terms, including *IAQ* (Indoor Air Quality), *KPI* (Key Performance Indicator), *P–D* (Physical–Digital), *PM* (Particulate Matter), *QR* (Quick Response Code), *SME* (Small and Medium Enterprise), and *VOC* (Volatile Organic Compound), allowing the discussion to remain both technically precise and accessible across disciplinary boundaries.

EMPIRICAL FOUNDATION: LITERATURE AND CASE STUDIES

The shift from sustainability to regeneration reframes interiors as *active agents* within living systems that circulate materials, energy, and meaning (Lyle, 1994; McDonough & Braungart, 2002; Mang & Reed, 2012). Within this lens, SMEs face constraints of capital, time, and expertise, yet they are well positioned to benefit from modular, low-toxicity, and place-attuned interventions that deliver ecological value and experiential quality in compact footprints. Regenerative scholarship converges on three tenets: (1) *Cycles and circularity replace linear consumption with biological/technical loops for safe return and reuse* (McDonough & Braungart, 2002); (2) *Place-based*

fit aligns design with nested social-ecological systems—local ecologies, labor, and culture (Mang & Reed, 2012); and (3) *Integrative processes privilege early, cross-functional collaboration and continuous feedback over after-the-fact mitigation* (Capra, 1996; Reed, 2009). To keep the literature compact yet actionable, *Table 1* groups key authors into thematic clusters and maps core ideas to SME-oriented implications.

Table 1: Literature review by thematic cluster. Source: author (2025).

Theme	Key Authors	Core Ideas & SME-Oriented Implications
<i>Regenerative cycles and circularity</i>	Lyle; McDonough & Braungart; Mang & Reed	Move from harm reduction to net-positive, using biological/technical loops and place-based fit. For SMEs: select upcyclable/biodegradable assemblies, plan take-back loops, tailor to local ecologies to cut waste and strengthen identity (Physical-Digital, Organizational, Technological, Social, Ecological).
<i>Integrative and systems process</i>	Reed; Capra	Use collaborative, feedback-driven design across nested systems. For SMEs: co-design with staff/suppliers, phase retrofits, track simple KPIs to de-risk investment and sustain adoption (Org, Tech, Social, Eco).
<i>Biomimicry and ecology informed design</i>	Benyus; Pawlyn	Derive low-energy, context-fitted strategies from nature. For SMEs: prefer bio-based finishes and ecosystem-inspired morphologies to reduce loads and improve durability (Physical-Digital, Tech, Eco).
<i>Multisensory and embodied experience</i>	Pallasmaa; Merleau-Ponty	Engage haptics, sound, smell; design for movement and touch. For SMEs: balance modalities and plan paths/proximities to increase comfort, memory, and wayfinding (Physical-Digital, Social).
<i>Sensory toolkit and atmosphere</i>	Malnar & Vodvarka; Erwine	Treat light, air, sound, temperature, and smell as primary media. For SMEs: tune lighting and acoustics, compose contextual scents, document user response with simple tools (Physical-Digital, Tech, Org).
<i>Affective design and memory</i>	Norman	Link emotion with usability and recall. For SMEs: use ambient cues at decision nodes to build trust, clarity, and memorability (Physical-Digital, Org).
<i>Restorative attention and performance</i>	Berto; World Green Building Council	Nature-linked cues support focus and well-being. For SMEs: add greenery/daylight and low-toxicity finishes to improve cognitive/health outcomes and operations (Physical-Digital, Eco, Org).

In parallel, sensory design research counters visual dominance and advances multisensory orchestration—explicit engagement of haptic, auditory, and olfactory modalities to shape affect, cognition, and behavior (Pallasmaa, 2005; Malnar & Vodvarka, 2004; Norman, 2004). Phenomenology underscores that perception is embodied: spatial meaning arises through movement, proximity, temperature, texture, and ambient sound (Merleau-Ponty, 1945). Practice-oriented texts emphasize “invisible media”—light, air, sound, temperature, and smell—as low-cost levers for comfort and meaning (Erwine, 2017). Evidence for restorative attention indicates that biophilic features

(daylight, greenery, natural textures) reduce stress and support cognition (Berto, 2005), while workplace syntheses associate healthy interiors with productivity gains and lower absenteeism (World Green Building Council, 2014).

For SMEs, these streams intersect as systems integration across five domains: Physical-Digital, Organizational, Technological, Social, and Ecological. Physical moves (materials, light, acoustics, layout) gain durability when aligned with organizational routines (maintenance, procurement), lightweight technologies (low-cost sensors, presets, dashboards), social interfaces (local suppliers, community programming), and ecological aims (circular flows, low toxicity). Collectively, these clusters suggest that small, cumulative changes—switching to lime or clay paints, adding planter-partitions, tuning light spectra and sound absorption, and instituting material take-back—align ecological and experiential outcomes when embedded in routine operations and monitored with simple metrics (e.g., dwell time, repeat visits, percentage of reclaimed materials).

The literature shows how regenerative priorities and multisensory composition are enacted in practice through localization, adaptive reuse, modularity, and curated atmospheres. While prominent brands are frequently documented, their strategies are scalable to SMEs by substituting local materials and prefabricated kits, relying on daylight-first layouts and soft acoustics, and employing lightweight digital layers (e.g., QR-linked storytelling, basic IAQ/noise sensing). *Table 2* synthesizes representative exemplars and translates them into transferable tactics.

Table 2: Case studies and transferable SME tactics. Source: author (2025).

Case	Regenerative/Sensory Strategies	Transferable SME Tactics & Simple Metrics
Aesop (permanent retail)	Reclaimed/local materials, passive strategies, minimal-waste build-outs; calm, place-aligned scent; tactile stone/wood; soft acoustics; daylight emphasis. Integration across Organizational routines (local commissioning), Ecological reuse, Social place-fit, and the Physical-Digital continuum (store ↔ online coherence).	Tactics: material-reuse kit; locally tuned scent palette; textile/wood acoustic absorption; daylight tuning. Metrics: % reclaimed materials; average dwell time; repeat-visit rate.
Patagonia (adaptive-retail)	Retrofit-first siting; salvaged wood; low-toxicity materials; tactile product storytelling; repair/activism touchpoints. Integration with Organizational repair culture, Social transparency, Ecological adaptive reuse, and Physical-Digital QR content/repair sign-ups.	Tactics: prioritize adaptive reuse; tactile narrative stations; in-store repair/demo corners. Metrics: embodied carbon avoided vs. new build; station interactions; number of repairs.
Lush Showcase (pop-up retail)	Modular, reusable exhibition structures; low-waste operations; scent-rich themed rooms; live demos; multimodal installations. Integration with Organizational event ops, Technological AV presets, Social advocacy, Ecological module reuse, and Physical-Digital event ↔ online content.	Tactics: pop-up modules for seasonal campaigns; multisensory zones; rapid reconfiguration playbooks. Metrics: waste diverted; conversion during events; social-media engagement.

In sum, the literature (*Table 1*) and the case studies (*Table 2*) converge on a pragmatic pathway for SMEs, in which: (1) *low-cost, multisensory, and regenerative interventions are phased in over time*; (2) *these interventions are aligned with existing organizational routines and supported by light digital feedback*; and (3) *a small set of clear KPIs (Key Performance Indicators) is monitored to enable rapid iteration*. This pathway maintains systemic coherence while remaining feasible in resource-constrained SME contexts, which are often marked by tight working capital, lease and permitting constraints, and lean staffing that limit design capacity and tolerance for downtime (OECD, 2021).

RESULTS

The results are consolidated into eight guidelines that SMEs can phase in with low to low-mid costs, while coordinating sensory mechanisms (affect, attention, memory) and regenerative levers (biophilia, circularity, low toxicity) across Physical-Digital, Organizational, Technological, Social, and Ecological systems (*Table 3*).

Table 3: Guidelines for sensory-regenerative design in SMEs. Author (2025).

Action (Guideline)	Implementation and Cost Profile (Systems View)	Simple KPIs (Before/After)
Integrate biophilia	Planter-partitions, hardy species, nature patterns, outdoor views. Cost: Low. Systems: Physical-Digital (basic IAQ checks), Social (care routines), Ecological.	Short stress scale; time-on-task; % interior greenery
Daylight-first + adaptive lighting	Light shelves/reflectors; high-CRI tunable LEDs; timers/presets. Cost: Low-Mid (relamping first). Systems: P-D, Technological, Ecological.	kWh/m ² ; visual-comfort rating; glare incidents
Calibrated soundscapes + absorption	Textile baffles; cork/wood panels; playlists by zone/daypart. Cost: Low to Low-Mid. Systems: P-D (audio presets), Social.	Perceived noise (dB + micro-survey); dwell time
Haptic material palettes	Wood/cork/textiles; lime/clay paints on touch-adjacent areas. Cost: Low-Mid (phase 10–20 m ²). Systems: Organizational (finish schedules), Ecological.	% low-toxicity area; product-touch rate
Context-aligned olfaction	Plant-based scents (low dose), locale/season tuning; rotation schedule. Cost: Low. Systems: P-D (rotation presets), Social (cultural fit).	Return-visit rate; stay duration; scent-tolerance micro-survey
Social/communal layouts (modular)	Reconfigurable seating; communal tables; clear paths/proximities. Cost: Low-Mid. Systems: Organizational (playbooks), Social.	Seat utilization; event participation
Circular/low-impact materials	Reclaimed shelving/counters/signage; supplier take-back clauses. Cost: Low-Mid (materials cheaper; labor varies). Systems: Organizational (procurement), Ecological, P-D.	% reclaimed; waste diverted (kg); embodied-carbon vs. baseline
Balanced sensory load (zoning)	Quiet vs. lively zones; layer light/sound/scent/touch without overload. Cost: Low. Systems: P-D, Technological, Organizational.	Customer satisfaction; time-in-zone; staff comfort

Grounded in the regenerative tradition (Lyle, 1994; McDonough & Braungart, 2002; Mang & Reed, 2012; Reed, 2007; Capra, 1996) and the multisensory/phenomenological canon (Pallasmaa, 2005; Malnar & Vodvarka, 2004; Norman, 2004; Merleau-Ponty, 1945; Erwine, 2017), and triangulated with practice from well-documented case studies—Aesop's site-responsive retail, SFER IK's bio-based exhibition architecture, Patagonia's adaptive-reuse stores, and Lush's modular showcase—the synthesis presented in *Table 3* distills design moves that consistently pair ecological levers (circularity, low toxicity, biophilia) with experiential mechanisms (affect, attention, memory). The convergences are translated into actions sized for SMEs and measured with simple, before/after indicators to facilitate implementation.

Taken together, the guidelines describe a cumulative pathway rather than isolated upgrades. Biophilic measures and low-toxicity finishes offer early, visible wins that support attention restoration and comfort while improving indoor environmental quality; the corresponding KPIs—short stress scales, time-on-task, and percentage of interior greenery—keep the loop practical for small teams. Daylight-first strategies, complemented by tunable LEDs and simple timers, reduce energy intensity and improve visual comfort; tracking kWh/m² alongside glare and comfort ratings helps teams tune scenes rather than over-light spaces.

Acoustic calibration—through textile baffles, cork or wood absorption, and curated playlists—moderates fatigue and improves dwell time. Here, combining quick dB snapshots with a one-question perception check provides enough feedback to refine materials and playlists by zone. Haptic palettes (wood, cork, textiles; lime/clay paints on touch-adjacent surfaces) deepen attachment and signal material care while reducing toxicity; monitoring the percentage of low-toxicity area and simple product-touch counts indicates whether the change is noticed where it matters.

Olfactory cues, when plant-based, low-dose, and contextually tuned, shape mood and memory without overpowering users; short tolerance checks, stay duration, and return-visit rates offer a lightweight read on acceptance and impact. Social layouts translate multisensory balance into behavior, with modular furniture and clear proximities enabling both conviviality and flow; seat utilization and event participation indicate whether the space is working for real interactions. Circular procurement anchors the regenerative ambition in everyday operations—reclaimed fixtures and take-back clauses reduce waste and embodied carbon; tracking percentage reclaimed, diverted waste, and embodied-carbon deltas guides future sourcing.

Finally, sensory zoning prevents overload by separating quiet and lively areas and layering cues intentionally; time-in-zone, satisfaction, and staff comfort help maintain equilibrium as programming changes. In sum, *Table 3* functions as a compact operating script: phase small interventions, measure with a few clear indicators, and align each move with organizational routines and light digital support. This rhythm enables SMEs to accumulate system-level gains in environmental performance and experiential quality without exceeding typical budget or staffing constraints.

DISCUSSION

The results indicate that sensory composition and regenerative intent reinforce one another when enacted as coordinated system moves across Physical–Digital, Organizational, Technological, Social, and Ecological layers (*Table 3*). In practice, biophilic cues and low-toxicity finishes improve indoor environmental quality while supporting attention regulation and comfort, echoing empirical work on restorative attention and healthy workplaces; curated soundscapes, haptic materiality, and contextual olfaction strengthen affect, memory, and wayfinding—the core mechanisms of experiential engagement described in the literature.

When these experiential levers are paired with circular procurement (reclaimed or bio-based assemblies, take-back agreements) and modular rollouts (phased, low-downtime interventions), SMEs accumulate ecological benefits and experiential gains without heavy capital expenditure. Three dynamics recur across contexts: (1) *experiential–ecological alignment* (tuning light, air, sound, and toxicity reduces operational loads while improving cognitive–affective outcomes), (2) *operational coherence* (reusable kits, preset libraries, and simple measurement cycles translate design intent into day-to-day routines under lean staffing), and (3) *narrative credibility* (sensory storytelling anchored in transparent material choices builds trust and place identity in compact interiors).

Barriers remain typical of SMEs—tight working capital, lease and permitting constraints, inherited shells, and limited design literacy—so even low-to-mid cost measures (e.g., acoustic absorption, tunable lighting) may be deferred against short cash-flow horizons. Knowledge gaps around multi-sensory balance (avoiding olfactory overload, managing reverberation) and systems integration (aligning procurement, maintenance, and lightweight sensing) further slow diffusion, and tenancy or heritage conditions may restrict daylight devices or specific finishes. These constraints do not negate feasibility; they underscore the value of phased pilots, unit-level KPIs (dwell time, percentage reclaimed, kWh/m², dB snapshots, brief stress/satisfaction scales), and staff playbooks that convert guidelines into repeatable routines. To make these trade-offs and responses explicit, the main synergies, barriers, and mitigations are consolidated into a summary table (*Table 4*) that serves as a quick decision aid for SME teams.

The most common frictions—capital, capability, and compliance—are addressable with pragmatic sequencing (start small, measure, iterate), standardized modules, and minimal digital layers for feedback. Because several obstacles are structural, enabling conditions beyond the firm are required and should prioritize low-friction adoption at SME scale. Four policy and ecosystem directions are especially actionable:

1. **Outcome-tied micro-incentives:** Small grants or tax credits earmarked for low-toxicity finishes, daylight devices, indoor greenery, and acoustic absorption, with two or three simple KPIs (e.g., % reclaimed, kWh/m², dB reduction) for accountability.
2. **Lightweight code and permitting pathways:** Fast-track approvals for reclaimed materials, modular partitions, light shelves, and temporary biophilic elements to reduce administrative friction for compact, reversible tenant improvements.

3. **Design literacy embedded in enterprise support:** Sensory-regenerative toolkits (specimen materials, acoustic “recipes,” scent guidance, measurement templates) integrated into local enterprise coaching and accelerator curricula to close capability gaps without consulting overhead.
4. **Shared infrastructure and procurement:** Material libraries, reuse exchanges, maker hubs, and framework contracts for modular kits (shelving, planter-partitions, acoustic baffles) to de-risk sourcing, compress learning curves, and provide scale pricing, with public-private pilots documenting pre/post outcomes and open playbooks.

These synergies, barriers, and policy levers are synthesized in *Table 4* below, which provides a concise decision aid for SME teams.

Table 4: Discussion summary. Author (2025).

Synergy Observed	Typical SME Barrier	Practical Mitigation
Biophilic measures improve cognition and indoor air quality while reducing lighting demand	Upfront purchase/maintenance; limited staff time	Begin with hardy species and mobile planter-partitions; assign micro-roles for care; track interior greenery (%) and a short stress scale (R: <i>Integrate biophilia</i>)
Daylight-first strategies lower energy use and improve visual comfort	Lease/heritage limits; glare risk; limited budget for openings	Use light shelves/reflectors and tunable LEDs; run quick glare audits; monitor kWh/m ² and comfort ratings (R: <i>Daylight + adaptive lighting</i>)
Acoustic comfort increases dwell time and reduces fatigue	Hard, reverberant surfaces; tight budgets	Install textile baffles/cork/wood absorption; curate playlists by zone/daypart; track dB plus a one-question perception check (R: <i>Calibrated soundscapes</i>)
Reclaimed/low-toxicity finishes reduce embodied impacts and add haptic quality	Irregular sourcing; compliance uncertainty	Build local reuse networks; include supplier take-back clauses; measure % reclaimed and waste diverted (R: <i>Circular/low-impact materials; Haptic palettes</i>)
Context-aligned scent strengthens memory and place identity	Overpowering or culturally mismatched notes	Use plant-based, low-dose palettes; rotate seasonally; gather brief tolerance feedback; observe return-visit rate (R: <i>Context-aligned olfaction</i>)
Modularity enables phased investment and shorter closures	Reconfiguration perceived as complex; lack of procedures	Standardize module sizes; develop staff playbooks for resets; track seat utilization and setup time (R: <i>Social/communal layouts; Balanced sensory load</i>)

Taken together, the coordinated application of sensory and regenerative moves, the mitigations consolidated in *Table 4*, and targeted ecosystem supports provide a pragmatic path for SMEs to realize coherent, system-level improvements in environmental performance and experiential quality despite lean staffing, constrained capital, and restrictive shells.

CONCLUSION

This article examined how regenerative and sensory design can be operationalized in SME interiors, with emphasis on retail and exhibition contexts. Drawing on the empirical foundation and the consolidated results matrix (*Table 3*), it showed that cost-aware interventions—biophilic integration, daylight-first lighting, calibrated soundscapes, haptic material palettes, contextual olfaction, circular/reclaimed finishes, and modular layouts—can align ecological performance with experiential quality when distributed across interconnected Physical–Digital, Organizational, Technological, Social, and Ecological systems. The Discussion then synthesized trade-offs and responses into a single decision aid (*Table 4*), clarifying how phased pilots, unit-level indicators, and staff playbooks can mitigate typical SME constraints.

The synthesis challenges the assumption that advanced sustainability and experiential design are exclusive to large, capital-intensive projects. Instead, it positions SMEs as sociotechnical agents capable of orchestrating multisensory, regenerative systems through phased retrofits, local sourcing, and light-touch digital feedback. Reported benefits from the literature and industry reporting—lower operating costs (often cited in the 9–30% range), improved employee productivity (approximately 10–25%), and superior customer-experience outcomes associated with revenue uplift—reinforce the practical and ethical case for action (World Green Building Council, 2014; Carbon Trust, 2015; Design Council, 2020; Harvard Business Review, 2014; Bain & Company, 2015).

Although effect sizes vary by context, the direction is consistent: interventions that reduce toxicity and waste, improve air and acoustic quality, and curate multisensory atmospheres tend to deliver dual ecological–experiential value in compact SME interiors. From a systems perspective, the most transferable patterns are: retrofit-first and reuse; daylight-first with acoustic softening; contextual scent and haptic touchpoints at decision nodes; and modularity to phase investment and minimize downtime. Coupled with simple metrics (e.g., dwell time, repeat visits, percentage of reclaimed materials, short stress scales, kWh/m², dB levels), these moves allow SMEs to iterate and learn without heavy data infrastructure. Nonetheless, longitudinal evidence specific to SME interiors remains limited.

Future research should: (1) *pair pre/post measurements*—IAQ (VOCs/PM), noise levels, energy intensity, dwell time, repeat visits, staff well-being—with cost and downtime tracking to clarify returns at SME scale; (2) *examine cultural fit for olfactory and haptic choices across locales and sectors, including tolerance thresholds and inclusivity* (e.g., scent-free policies); (3) *test modular rollouts using mixed methods* (brief physiological proxies plus ethnographic observation) to isolate mechanisms linking multisensory cues to attention, memory, and behavior in small-footprint spaces; (4) *assess policy scaffolds*—micro-grants, permitting fast tracks for reclaimed/biophilic elements, material libraries, and design-literacy programs—to determine which combinations most effectively lower adoption barriers; and (5) *extend the Physical–Digital layer*, comparing low-cost sensing/presets and QR storytelling with more advanced systems to establish the minimal viable digital stack for SMEs.

In sum, the evidence points to a pragmatic pathway in which SMEs leverage regenerative materials and multisensory composition to enhance environmental outcomes, human well-being, and brand credibility. With targeted policy support and cumulative, measured upgrades, SMEs can act as agents of ecological and cultural renewal, transforming everyday interiors into restorative, memorable experiences.

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