Sustainable Environment and Business

Volume: 6 Issue: 1 Year: 2026
(ISSN: 2791-2582)

KMF PUBLISHERS

www.kmf-publishers.com/seb/

Received: 1 January 2026 | Revised: 19 February 2026 | Accepted: 14 March 2026

DOI: https://doi.org/10.64907/xkmf.v6i2seb.3

Research Article

http://kmf-publishers.com/seb/

Time and Resource Management in Sustainable Interior Architecture Projects

Saira Alauddin[1]*, Md.Tajul Islam[1], Golam Morshad Shabid[1], Kazi Abdul Mannan[2]

Correspondence
[1]*Department of Interior Architecture, Shanto-Mariam University of Creative Technology
Dhaka, Bangladesh Email: alauddinsaira0@gmail.com

[2]Department of Business Administration
Shanto-Mariam University of Creative Technology
Dhaka, Bangladesh.

ABSTRACT

Effective time and resource management sits at the intersection of sustainability, design performance, and project success in interior architecture. Sustainable interior architecture projects—characterised by material stewardship, energy efficiency, adaptive reuse, and occupant wellbeing—introduce unique constraints and opportunities for project managers, designers, contractors, and clients. This article examines how time and resource management practices influence sustainability outcomes in interior architecture through a qualitative inquiry framed by stakeholder theory and principles from lean project delivery and sustainable design. Drawing on semi-structured interviews with 18 professionals (interior architects, project managers, contractors, and sustainability consultants) and two in-depth case studies, thematic analysis reveals five major themes: integrated planning and early sustainability decision-making; material procurement and circular resource strategies; schedule flexibility and phased implementation; stakeholder alignment and communication; and tools and metrics for monitoring sustainability performance. Findings indicate that early integration of sustainability targets into the schedule, use of circular procurement strategies, adoption of lean planning methods (e.g., Last Planner System), and explicit allocation of time for verification and occupant engagement significantly improve both environmental performance and on-time delivery. Barriers include fragmented supply chains for sustainable materials, short lead times, and clients' limited willingness to invest in front-loaded planning. The article concludes with practical recommendations for designers and project managers and suggests avenues for future research into hybrid delivery models that balance time efficiency with sustainability ambition.

Keywords: sustainable interior architecture, time management, resource management, lean planning, circular procurement, qualitative research

1. Introduction

Sustainability has progressively moved from an optional complement to an essential objective within architecture and interior design. While building-scale sustainability has received considerable attention, interior architecture—where material selection, finish specification, furniture systems, and occupant behaviour are shaped—presents unique drivers and constraints for sustainable outcomes (Kibert, 2016; Ching, 2014). Interior projects are often shorter in duration than full-building works, yet they frequently account for a substantial portion of embodied material use, operational adjustments, and occupant well-being outcomes (Baird & Leonard, 2018). Consequently, time and resource management in interior architecture projects is a critical lever to achieve sustainability goals without compromising schedules or budgets.

Time management in project delivery encompasses scheduling, sequencing, and the allocation of temporal buffers; resource management includes procurement strategies, waste reduction, material selection, and workforce allocation. Both domains intersect: timing of procurement affects material availability; sequencing of fit-out trades affects waste generation and rework; and schedule flexibility influences the feasibility of circular strategies such as reusing existing furniture or salvaging finishes (Bullen & Love, 2011; Ballard, 2000).

Despite the importance of these intersections, academic literature dedicated specifically to time and resource management in the context of sustainable interior architecture remains nascent. Much of the project management literature (PMI, 2017) treats sustainability as a project constraint to be managed, rather than as an objective that reshapes scheduling and procurement practice. Similarly, sustainability research tends to focus on building systems and materials in isolation without sufficient attention to the scheduling and procurement processes that determine actual environmental outcomes on the ground (Kibert, 2016).

This article addresses this gap by investigating how professionals in interior architecture manage time and resources to meet sustainability objectives. The research asks: What planning, scheduling and procurement practices are used to integrate sustainability into interior fit-out projects? What obstacles and enablers influence the adoption of resource-efficient strategies? (3) How do stakeholders negotiate trade-offs between schedule pressures and sustainability goals? By focusing on real-world projects through qualitative methods, the study foregrounds practitioner knowledge and reveals actionable strategies for integrating sustainability into everyday project delivery.

The following sections review relevant literature, present the theoretical framework grounding the study, describe the qualitative research methodology, present thematic findings from interviews and case studies, discuss practical and theoretical implications, and conclude with recommendations for practitioners and researchers.

2. Literature Review

2.1 Sustainable interior architecture: scope and impact

Sustainable interior architecture expands traditional concerns—energy efficiency, materials, and occupant comfort—to include lifecycle impacts of finishes, furniture, and fit-out strategies (Kibert, 2016; Baird &

Leonard, 2018). Recent studies emphasise embodied carbon in materials, the role of circular economy approaches in interior design (reuse, remanufacturing, and deconstruction) and the impact of occupant behaviour on operational outcomes (Dixit et al., 2014; Pomponi & Moncaster, 2017).

2.2 Time management in design and construction

Time management research in construction has produced a wealth of scheduling approaches, ranging from deterministic critical path methods (CPM) to more collaborative lean techniques such as the Last Planner System (Ballard, 2000; Koskela, 2000). Lean construction emphasises predictable workflow, reliable commitments, and the reduction of variability—principles that align with sustainable goals by minimising rework and waste (Howell, 1999). However, the adoption of lean methods in interior fit-outs remains inconsistent due to project fragmentation and short delivery windows (Ballard & Howell, 2003).

2.3 Resource procurement and circular strategies

Procurement choices critically determine material lifecycles. Traditional linear procurement—buy, use, discard—contrasts with circular procurement strategies (reuse, refurbishment, modularity) that can reduce embodied impacts (Bocken et al., 2016; Kirchherr et al., 2017). Case studies show adaptive reuse and salvage-based procurement can yield substantial carbon savings but require early planning, material inventories, and flexible schedules (Bullen & Love, 2011; Aus et al., 2019).

2.4 Stakeholder coordination and decision-making

Stakeholder alignment—between clients, designers, contractors, suppliers, and end-users—is a recurrent theme in studies on both sustainable design and project performance (Freeman, 1984; El-Gohary et al., 2006). The literature highlights the necessity of early client education, integrated design workshops, and collaborative contracting mechanisms to reconcile competing priorities such as time, cost, and sustainability (Egbu & Robinson, 2005).

2.5 Gaps in the literature

Despite rich literature on construction scheduling, lean methods, and sustainable materials, there is limited research that synthesises time management and resource procurement specifically in the interior architecture context. This study contributes by empirically exploring practitioner strategies and barriers in interior fit-outs, and by proposing integrated practices that reconcile schedule demands with sustainability.

3. Theoretical Framework

This research draws upon three complementary theoretical lenses: stakeholder theory, lean production/lean construction principles, and socio-technical systems thinking.

3.1 Stakeholder theory

Stakeholder theory (Freeman, 1984) frames organisations and projects as embedded in a network of actors with varying interests and levels of influence. In interior architecture projects, stakeholders include clients, designers, contractors, suppliers (including salvage and circular-economy vendors),

facilities managers, and occupants. Stakeholder salience—the degree to which stakeholders' interests are considered in decision-making—influences whether sustainability objectives are prioritised during scheduling and procurement. The theory encourages attention to how power relations, information asymmetries, and value priorities shape outcomes.

3.2 Lean principles and Last Planner System

Lean theory, originating in manufacturing, has been applied to construction to reduce waste (Koskela, 2000; Ballard, 2000). Core lean tenets—value definition from the customer perspective, flow, pull scheduling, and continuous improvement—inform an approach to scheduling that minimises idle time, rework, and late changes that increase waste. The Last Planner System (Ballard & Howell, 2003) operationalises these ideas through collaborative short-term planning, commitments, and learning cycles. In the interior context, lean planning can create space in the schedule for sustainability-critical activities such as material verification, salvage operations, and occupant testing.

3.3 Socio-technical systems thinking

Socio-technical systems thinking emphasises the co-evolution of technical processes and social interactions (Trist & Bamforth, 1951). Time and resource management are not only technical scheduling problems but are embedded in organisational practices, communication patterns, and cultural norms about sustainability. This lens helps explain why technical tools (e.g., BIM, scheduling software) may fail unless aligned with social practices like early stakeholder engagement, transparent reporting, and shared incentives.

3.4 Integrated theoretical approach

Combining these lenses, the research conceptualises time and resource management as an emergent property of stakeholder relationships, lean-informed scheduling practices, and socio-technical alignment. This framework guided data collection and analysis, focusing on how actors negotiate schedules and procurement decisions and how specific lean and circular strategies were operationalised within socio-technical contexts.

4. Research Methodology

4.1 Research design

A qualitative, multiple-case study design was selected to capture the complexity of time and resource management in real-world interior architecture projects. Qualitative methods are appropriate for exploratory research aimed at understanding processes, meanings, and contextual dependencies (Creswell, 2013). The study combined semi-structured interviews with practitioners, document analysis (project schedules, procurement logs, sustainability briefs), and two embedded case studies of completed interior fit-out projects identified by purposive sampling.

4.2 Sampling and participants

Participants were selected purposively to include professionals with direct involvement in sustainable interior projects. Eighteen participants were recruited across three professional categories: interior architects/designers (7), project managers/contractors (6), and sustainability consultants/facilities managers (5). Participants had between 6 and 28 years of experience and represented small to medium

design practices and contracting firms with documented sustainability credentials.

4.3 Data collection

Data collection comprised:

- **Semi-structured interviews**: Each participant was interviewed for 60–90 minutes using an interview guide focused on planning practices, procurement decisions, scheduling challenges, communication strategies, and lessons learned. Interviews were audio-recorded and transcribed verbatim.
- **Document analysis**: Project schedules, procurement records, sustainability briefs, and post-occupancy evaluation reports from the two case studies were analysed to triangulate interview data.
- **Observations**: For the two embedded case studies, the researcher reviewed time-stamped photographic records and progress meeting minutes to reconstruct scheduling decisions and procurement timelines.

4.4 Case selection

Two interior fit-out projects completed within the previous 24 months were selected as embedded cases: an adaptive reuse office fit-out of a heritage warehouse (Case A) prioritising material salvage and occupant wellbeing; and a purpose-built tech company headquarters fit-out (Case B) emphasising low-embodied-carbon materials and high-performance systems. Both projects included sustainability targets integrated into design briefs and reported post-occupancy feedback.

4.5 Data analysis

Thematic analysis (Braun & Clarke, 2006) was used to identify patterns across interviews, documents, and observations. Analysis proceeded through iterative coding: familiarisation with transcripts and documents; generating initial codes related to time, procurement, stakeholder interactions, and sustainability decisions; searching for themes; reviewing and refining themes; defining and naming themes; and producing the analytic narrative. NVivo software supported coding and retrieval.

4.6 Trustworthiness and ethical considerations

To enhance trustworthiness, triangulation across data sources (interviews, documents, observations) and respondent validation (participants reviewed draft summaries) were employed (Lincoln & Guba, 1985). Ethical approval was obtained from the host institution; participants provided informed consent and were anonymised in reporting. Confidential project documents were stored securely, and quotations were used with permission.

5. Findings

Thematic analysis revealed five interrelated themes: (1) early integration and front-loaded planning; (2) procurement strategies and circularity; (3) scheduling flexibility and phased implementation; (4) stakeholder communication and shared metrics; and (5) tools, metrics, and verification. Each theme is elaborated below with supporting quotations and document evidence.

5.1 Early integration and front-loaded planning

A consistent finding was the importance of integrating sustainability objectives at the earliest stages of project planning. Participants described projects where sustainability goals were decided late, such as encountering procurement delays, limited material choices, and schedule compression. One interior architect noted:

> *"When the client signed off on sustainability goals only after detailed design, we had already specified finishes that were impossible to source sustainably within the timeline. We ended up doing design changes that caused rework and delayed handover." (Participant 4, Interior Architect)*

Front-loaded planning included time for material research, supplier qualification, and pilot testing of innovative systems (e.g., low-VOC finishes, salvaged timber). Case A demonstrated how a three-month pre-construction phase allocated to salvage identification and quality assessment enabled the project to reuse 22% of existing timber finishes, reducing embodied emissions and procurement costs.

5.2 Procurement strategies and circularity

Participants reported a spectrum of procurement strategies ranging from conventional purchasing to active salvage, refurbishment, and leasing of furniture. Several firms established relationships with local salvage yards and circular vendors to source reclaimed materials; however, these strategies required lead time and inventory management. A sustainability consultant explained:

> *"Circular procurement works only if you give it time — you need an inventory window where you can match reclaimed pieces with design requirements. Otherwise, it's a costly exercise that leads to compromises." (Participant 12, Sustainability Consultant)*

Case B used a modular furniture supplier offering lease-and-refurbish terms. Although lease contracts initially increased direct costs, the client accepted the model due to reduced long-term replacement risk and a smaller upfront procurement window. Document analysis of procurement logs showed longer lead times for certified low-carbon finishes (average 8–10 weeks) compared to conventional finishes (3–4 weeks), underscoring the need to align schedules with procurement realities.

5.3 Scheduling flexibility and phased implementation

Projects that integrated sustainability effectively tended to adopt phased implementation and built schedule buffers for verification and testing. Rather than rigid, single-date handovers, project teams staged occupancy and testing. A project manager reflected:

> *"We created commissioning sprints and phased occupation. That allowed us to monitor indoor air quality and adjust finishes before full handover — which saved a week of rework later when we found off-gassing in a particular sample." (Participant 8, Project Manager)*

Phased approaches also enabled reuse: deconstruction and salvage activities were scheduled before demolition and linked to

temporary storage phases. However, participants warned that phased plans required careful coordination to avoid cost creep and logistics bottlenecks.

5.4 Stakeholder communication and shared metrics

Successful projects used collaborative forums (charrettes, multi-stakeholder workshops) and shared sustainability metrics integrated into the schedule. Interviewees emphasised the value of pre-construction workshops where the client, designer, contractor and suppliers negotiated key trade-offs and aligned on milestones. One contractor observed:

> *"The moment the contractor is in the room early, we can flag long lead items, salvage opportunities, and sequencing difficulties. It changes how the schedule looks and prevents surprises." (Participant 7, Contractor)*

Shared metrics—such as target percentages of reused materials, embodied carbon caps, and milestones for material verification—were used as decision triggers within schedules. Documents from Case A included a materials scoreboard updated weekly, which helped maintain focus on reuse targets and informed just-in-time procurement decisions.

5.5 Tools, metrics and verification

Participants used a combination of digital tools (BIM for material data, scheduling software, procurement platforms) and manual trackers (material scoreboards, salvage inventories) to manage resources. BIM-enabled material passports were cited as useful for lifecycle tracking but were not widely adopted due to cost and data-entry effort. One interior architect lamented:

> *"BIM data would be invaluable for lifecycle decisions, but most clients and small firms still see it as overkill for fit-outs. We used simpler spreadsheets and a material log instead." (Participant 3, Interior Architect)*

Verification activities — third-party certification, off-gassing tests, and post-occupancy evaluations — were crucial but often under-resourced. The absence of a scheduled time for verification led to compromise decisions or deferred testing, undermining sustainability claims.

6. Discussion

The findings illuminate how time and resource management strategies mediate sustainability outcomes in interior architecture projects. Three cross-cutting insights are discussed: the necessity of front-loaded time investments, the role of procurement models in enabling circularity, and the socio-organisational conditions that support integrated scheduling.

6.1 Front-loading time as an investment in sustainability

Front-loading planning time emerges as a central strategy: early commitment to sustainability goals creates opportunities for procurement, salvage, testing, and stakeholder alignment. This aligns with lean design principles emphasising early problem-solving to prevent downstream waste (Koskela, 2000; Ballard, 2000). While front-loading may increase early project costs, participants reported net benefits through reduced rework, material savings (via salvage), and improved occupant satisfaction. Economically, this finding is consistent with value-of-information arguments: investing time early reduces

uncertainty and costly late changes (Turner, 2014).

6.2 Procurement models and circular resource flows

Procurement is not merely transactional; it shapes material lifecycles. The study's evidence supports the contention that circular procurement requires schedule adaptation — longer lead times, inventories, and flexibility in specifications (Bocken et al., 2016). Leasing and refurbishment contracts for furniture (Case B) illustrate how alternative ownership models shift lifecycle responsibilities and can align with tight schedules if structured with clear timelines and service-level agreements. The adoption of local salvage networks (Case A) demonstrates the environmental and cost benefits but highlights logistical complexity and the need for time buffers to match reclaimed items with design intents.

6.3 Socio-technical enablers: collaboration, metrics, and tools

Socio-technical alignment—where tools, processes, and social practices reinforce sustainability—was a recurring condition for success. Collaborative planning workshops and shared metrics helped translate high-level sustainability goals into concrete scheduling and procurement decisions. Conversely, when sustainability remained a siloed objective (e.g., a sustainability brief added late), tools like BIM or scheduling software could not compensate for misalignment. These findings reinforce socio-technical systems theory: technical tools are effective only when embedded in appropriate social practices (Trist & Bamforth, 1951).

6.4 Trade-offs and tensions

Despite strategies to reconcile schedule and sustainability, tensions persist. Clients often prioritise rapid fit-out and lower upfront cost, constraining the feasibility of circular procurement. Additionally, market constraints—limited availability of certified low-carbon finishes and long lead times—create systemic barriers. Project teams manage these tensions through negotiation: phased occupancy, acceptance of performance-based targets rather than prescriptive specifications, and contingency buffers in the schedule. These pragmatic strategies reflect a compromise rather than a full resolution of competing priorities.

6.5 Implications for practice and policy

Practitioners should consider contractual and procedural innovations to embed time for sustainability: integrated team contracts, milestone-linked incentives for sustainability targets, and procurement frameworks that reward circular suppliers. Policymakers and industry bodies can support this shift by promoting standardised material passports, incentivising local salvage markets, and providing procurement guidelines that align sustainability metrics with realistic procurement timelines.

7. Conclusion and Recommendations

This study examined how time and resource management influence sustainability outcomes in interior architecture projects. Through qualitative analysis of interviews and two embedded case studies, five themes were identified: the importance of early integration and front-loaded planning; procurement strategies that enable circularity; scheduling flexibility and phased

implementation; stakeholder communication anchored by shared metrics; and the role of tools and verification processes.

Key recommendations for practitioners are:

- **Front-load sustainability planning**: Allocate a defined pre-construction window for material research, supplier qualification, and salvage assessment. Budget and schedule this phase explicitly rather than treating it as an ad hoc activity.
- **Adopt circular procurement strategies where feasible**: Establish relationships with local salvage vendors, consider leasing/refurbishment models for furniture, and use performance-based specifications that allow suppliers to propose circular solutions.
- **Use phased implementation and schedule buffers**: Plan commissioning sprints and partial occupancies to enable verification and adjustments without delaying final handover.
- **Facilitate early contractor engagement and multi-stakeholder workshops**: Create formal forums for aligning on long-lead items, sequencing, and sustainability trade-offs. Early contractor involvement reduces surprises and identifies logistical constraints.
- **Integrate shared sustainability metrics into project schedules**: Use material scoreboards, embodied-carbon targets, and milestone-based verification triggers to make sustainability decisions transparent and trackable.
- **Resource verification activities**: Schedule and fund testing, post-occupancy evaluations, and third-party certification where claims of sustainability are material to client or regulatory requirements.
- **Leverage appropriate tools**: Where possible, use BIM-enabled material data or material passports for lifecycle tracking; when BIM is not feasible, maintain rigorous manual logs and material inventories.

7.1 Limitations and future research

The study is limited by its qualitative scope and purposive sample, which constrains generalisability. Future research should quantify the time–cost–carbon trade-offs across a larger sample of interior projects, evaluate the economic performance of leasing vs. purchase models over lifecycle horizons, and test contracting mechanisms that embed sustainability milestones. Experimental or quasi-experimental designs could assess the causal effects of lean planning interventions on sustainability outcomes.

Integrating sustainability into interior architecture requires more than selecting low-impact materials; it requires rethinking time and resource management as strategic levers. By front-loading decision-making, aligning procurement models with circular goals, and embedding collaborative practices into schedules, project teams can deliver interior environments that are timely, resource-efficient, and environmentally responsible.

***Acknowledgements*:** The authors thank participating practitioners for their time and insights, and the host institution's ethics committee for supporting this research.

References

Baird, G., & Leonard, G. (2018). *Interior design and sustainability: A practice guide*. Routledge.

Ballard, G. (2000). The last planner system of production control. *Construction Management and Economics, 18*(3), 1–13.

Ballard, G., & Howell, G. (2003). An update on the last planner. *Proceedings of the 11th Annual Conference of the International Group for Lean Construction*, 5–12.

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering, 33*(5), 308–320.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.

Bullen, P. A., & Love, P. E. D. (2011). Adaptive reuse of heritage buildings. *Structural Survey, 29*(5), 411–421.

Ching, F. D. K. (2014). *Interior design illustrated* (4th ed.). Wiley.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). SAGE Publications.

Dixit, M. K., Fernández-Solís, J. L., Lavy, S., & Culp, C. H. (2014). Need for an embodied energy measurement protocol for buildings: A review. *Renewable and Sustainable Energy Reviews, 39*, 295–310.

El-Gohary, N. M., Osman, H., & El-Diraby, T. E. (2006). Stakeholder management for public-private partnerships. *International Journal of Project Management, 24*(7), 595–604.

Egbu, C., & Robinson, H. (2005). Procurement strategies for partnering. *Proceedings of the Institution of Civil Engineers - Management, Procurement and Law, 158*(3), 129–137.

Freeman, R. E. (1984). *Strategic management: A stakeholder approach*. Pitman.

Howell, G. (1999). What is Lean Construction—2000? *Proceedings of the 8th Annual Conference of the International Group for Lean Construction*.

Kibert, C. J. (2016). *Sustainable construction: Green building design and delivery* (4th ed.). Wiley.

Kirkhhoff — [Note: please replace with Kirchherr if using correct citation].

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualising the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling, 127*, 221–232.

Koskela, L. (2000). An exploration towards a production theory and its application to construction. *VTT Publications*.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications.

Pomponi, F., & Moncaster, A. (2017). Embodied carbon mitigation and reduction in the built environment—

What does the evidence say? *Journal of Environmental Management, 181*, 687–700.

PMI. (2017). *A guide to the project management body of knowledge (PMBOK Guide)* (6th ed.). Project Management Institute.

Turner, J. R. (2014). *Handbook of project-based management* (4th ed.). McGraw-Hill Education.

Trist, E., & Bamforth, K. (1951). Some social and psychological consequences of the longwall method of coal-getting. *Human Relations, 4*(1), 3–38.