Material Sustainability in Construction: Understanding Sustainable Value Proposition and Institutionalized Routines

Shrikarpagam Dhandapani[1]; and Ashwin Mahalingam, Ph.D.[2]

[1]Research Scholar, Dept. of Civil Engineering, Indian Institute of Technology Madras, Chennai, India. (corresponding author) Email: ce21d002@smail.iitm.ac.in
[2]Professor, Dept. of Civil Engineering, Indian Institute of Technology Madras, Chennai, India. Email: mash@civil.iitm.ac.in

Background

Sustainable construction is "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction" (U.S Environmental Protection Agency). Sustainable construction encompasses multiple components such as energy efficiency, water efficiency, material sustainability, indoor environmental quality, etc., across the different phases of a building's life cycle. Material sustainability, one of the components of sustainable construction, is defined as “using less new material to achieve the same goals” (Allwood, 2012). Material sustainability in construction is significant because the sector, on the one hand, consumes substantial material resources and, on the other hand, discards materials without fully utilizing their potential.

Although sustainability in construction could be achieved through deploying various tools and sustainable technologies spanning across the different phases of a building lifecycle, the construction industry has been notably slow to adopt the different components of sustainable construction, including material sustainability. Through a systematic literature review, we recognize the quantum of challenges and intricacies surrounding the uptake of sustainable construction. The challenges to sustainable construction can be chiefly categorized into financial, regulatory, social, and industry-related barriers (Du Plessis, 2007; Darko et. al, 2016; Akadiri et. al, 2015; Gan et. al, 2015; Durdyev, 2018; Maqbool, 2023; Ahn et. al, 2021; Hwang et. al, 2023). The review unveils that more than technological challenges or financial constraints, the predominant factors resisting the transition towards sustainable construction are management or coordination challenges at the project level, supply chain dependency issues at various levels within the industry, and the social barriers at the micro-level, such as environmental consciousness, awareness, and acceptance.

Theoretical Framing and Research Objectives

In line with the understanding of barriers to sustainable construction, theoretical literature on other domains of sustainability transitions, such as renewable energy, emphasizes the significance of ***business model innovation*** *(changes in value proposition of firms, innovations in supply chain, etc) and* ***institutional changes*** *(changes in norms, existing patterns of working, stakeholder beliefs, etc)* in overcoming the barriers to sustainability implementation alongside technological advancements.

Correlating this understanding to the context of the study, we observe from the literature that although organizations are highlighted as important enablers to achieving sustainable

construction (Glass & Dainty, 2011), interventions for sustainable construction rarely incorporate an organizational perspective; rather, they focus more on project-level solutions or policy-level solutions.

Sustainable value proposition denotes organisations changing their core business activities that contributes to economic benefits of an organisation into more environmentally friendly ones (Schaltegger, 2012). However, the scarce understanding of how the organisations in the AEC industry attempt to change their value proposition towards sustainable construction leads to our first research question:

RQ1: How do AEC organisations attempt to embed 'sustainability' into their existing value proposition?

While there are opportunities for organisations to embed sustainability into their practices, there are factors that constrain them from doing so or from achieving it. While studies highlight stakeholders' resistance to adopting sustainable construction, there is limited understanding of why and how this resistance to change occurs, particularly from an organisational perspective. Thus, we derive our second research question to understand the factors causing resistance and the interdependencies among them through the lens of institutional theory.

RQ2: How do the institutionalized practices affect the sustainable value proposition of AEC firms?

With these conceptual framing and research questions, the primary motivation of the study is to explore business innovation opportunities and deepen understanding of the challenges organisations face in achieving material sustainability in construction. This study is a work-in-progress with data collection ongoing. The intention of this paper is to present the emerging themes and preliminary findings from the qualitative analysis for the aforementioned research questions.

Research Methodology

We employ a qualitative research methodology to answer the *'how'* research questions (Yin, 1994). Given the objective of the study to understand the opportunities and challenges to material sustainability in construction, the data is obtained through semi-structured interviews with participants representing the key categories of construction organizations across the different phases of a building life cycle. They include material manufacturers, developers or clients, builders and contractors, project managers, sustainability consultants and recycling facilities.

The key idea of the qualitative interviews is to get participants to discuss their organisation's sustainability initiatives and practices, as well as the challenges in implementing them. The interviews were audio-recorded with participants' consent and transcribed. Additionally, we utilize secondary data sources (Chandrasekar et al., 2024) such as recordings of panel discussions, which helps overcome geographical bias and provide access to early and open information (Webb, 2017). Table 1 provides a brief overview of the data sources of the study.

Table 1: Data sources

Type of data	*Description*	*Data sources collected*	*Representative of*
Primary sources (PS)	Semi-structured interviews	34	Manufacturing firms, Consulting firms, Contractors, Developers, Project Management firms, Recycling facilities
	Documented data	9	
Secondary Sources (SS)	Recordings of panel discussions	13	
No. of hours of recording	45 hours 28 minutes		

The research questions are answered through qualitative data analysis using transcripts, open coding, and categorization of the qualitative data (Strauss & Corbin, 1990) to explore how AEC organisations embed sustainability into their existing value proposition and to understand the challenges in doing so.

Overview of the Qualitative Data and Emerging Themes

The qualitative data obtained from the participants, as mentioned above, consists of the viewpoints of different categories of organisations in the AEC sector. Participants discuss how their organisations are incorporating sustainability into their existing practices. The data ranges from basic compliance-related sustainability initiatives to advanced, proactive sustainability measures organisations undertake. Participants were also probed about the challenges in implementing the different sustainability initiatives. Below are the themes that are emerging from the preliminary analysis of the qualitative data.

1. 'Sustainable value proposition' of AEC firms

The data showcases instances of organizations that intend to deliver an 'ideal' (Stubbs & Cocklins, 2008) or 'desired' value proposition to contribute to the momentum towards sustainability transitions, as indicated in Table 2. For example, consulting firms seek to provide design inputs to achieve positive sustainability outcomes, such as operational or design efficiency in a building. Similarly, manufacturing firms intend to move from massive construction technologies to lightweight solutions or to substitute conventional products with low-carbon building materials.

Table 2: Sustainable Value Propositions of Organizations

Organisational Category	*Sustainable Value Proposition towards material sustainability*
Material manufacturing firms	Low-carbon building products
	Light-weight products and solutions
Consulting firms	Enabling manufacture of low-embodied carbon building products
	Enabling design and construction of low-embodied carbon buildings
	Enabling adaptive reuse of existing buildings
	Enabling deconstruction and reuse of materials

In some cases, organizations have delivered the value they aspire to, creating a significant sustainability impact. In contrast, in some cases, they have not achieved the desired value proposition, resulting in a low or no sustainability impact. The intent here is not to assess whether these organizations have delivered sustainability value, but to understand how they have attempted to integrate 'sustainability' into their existing value proposition.

2. *Potential business model reconfigurations for sustainability*

The data also suggests potential opportunities for business model reconfigurations of construction organisations that successfully integrate sustainability measures as indicated in Table 3. The difference between changes in value proposition, as mentioned above, and changes in business models is the scale of innovation that organisations implement- while the former is incremental, the latter is more radical or transformative in nature. For instance, material manufacturing firms have transformed into solution providers, getting involved in the design and construction phase of a building alongside product manufacturing. Two case examples from the data demonstrate that the business model reconfiguration from product to solution effectively helps overcome challenges in construction with alternative technologies, such as lightweight or low-carbon materials, such as timber.

Table 3: Case examples of business model reconfigurations

Organisational Category	***Sustainable Value Proposition and Description***	***Business model reconfiguration***
Material manufacturing firms	Low-carbon building products (Timber)	Building as a Product (Manufacture, design, and installation on site)
	Light-weight solutions (Concrete)	Manufacture of products to customized building solutions

3. Significance of 'sustainability value' alignment between the project stakeholders

The qualitative data showcases that, along with changes in the value proposition of individual organisations, value alignment between the other project stakeholders is equally important for better sustainability outcomes. For instance, data showcases that developers who do not intend to deliver a sustainability value proposition to their clients or who are not aware of the potential for incorporating sustainable building concepts during the design do not involve sustainability consultants early in the projects, but rather include them towards the later stages, to fulfil the basic certification or mandatory requirements. Once designs have been frozen, the consultants have little scope to deliver on the value proposition they intend to provide. A senior professional from a sustainability consulting firm noted,

"The moment when you're talking about the green building, you have to strike a balance between active and passive elements. Your orientation, where you are housing your windows, where you are housing your sun barriers, and all of this. But as per my experience, close to 95% of the projects, when we get in, all this design has already been frozen. Incorporating most of these requirements may not be feasible. We really don't have much scope on these passive concepts."

Similarly, in some projects in which stakeholder values do not align, sustainability analyses, such as energy simulations or life-cycle analysis (LCA), are performed as checkbox exercises rather they informing the building design and construction. The data also showcases instances of stakeholder value alignment leading to positive and impactful sustainability outcomes in a project.

4. Institutionalized routines constraining the sustainable value proposition of organisations

Our qualitative analysis identifies three interrelated categories of resistance to organisations delivering sustainability value as described in Table 4. The factors that cause resistance to organisations fit within any of these categories: first is the embedded institutions which denotes stakeholder perception or beliefs, mental models, sustainability interest, etc; second is the organisational memory which denotes factors of influence at the organisational level such as the structure, processes and practices, resources and capabilities; third is the institutional environment which denotes the field-related or external factors of influence, such as standards of practice, mandates, policies, etc. This categorization supports the identification of the predominant factors driving resistance and the interdependencies across levels. Specifically, emerging insights into the significance of cognitive or micro-level factors are unique and interesting, and most of the literature has not considered them.

Table 4: Institutionalized routines resisting a sustainable value proposition

Type of institutionalized routines	Illustrative Category (Resistance to delivering a sustainable value proposition)	Illustrative Excerpts
Embedded Institutions	Correlating recycled materials to lower strength	*"When we say secondary steel, people tend to think that the quality is also secondary. So, we had to introduce a mobile real-time testing facility to show that the quality is on par… in fact, higher than the primary steel."*
Organisational memory	Non-inclusion of sustainability elements in tender, BOQ, and contract documents	*"Unless it is there in the BOQ, it doesn't get implemented. In one of our early projects, we missed mentioning some of the (low-carbon) material specifications, and it was a tedious experience. Now, we tell our clients, please do not give it to any vendors before our approval. Otherwise, you cannot hold them responsible, and there is a blame game."*
Institutional environment	Immature deconstruction practices	*"Drywall is actually a very sustainable material… it is infinitely recyclable. But the only concern is how they are taken out during the demolition process. If it is mixed with other materials, I cannot use it again."*

5. Institutional work: Conditions enabling the sustainable value proposition of organisations

Although we observe many institutionalized practices that cause resistance to sustainability implementation, the data also indicate a few instances in which stakeholders navigate these routines and successfully deliver the sustainability values they intend to. A few cases from the data show that, despite the extensive efforts, longer time, and a higher cost, clients were keen to implement sustainable construction practices. This signifies that 'institutional work', purposeful actions by individuals and organizations aimed at creating, maintaining, and disrupting institutions (Lawrence & Suddaby, 2006). Institutional work undertaken by the organizations, particularly the clients, play a critical role in navigating the existing norms, behaviours, and culture of stakeholders and enabling 'sustainability value' in construction projects. The enabling conditions also imply external situations such as regulatory environment that contribute to enabling sustainable value propositions of organisations. Some illustrative conditions derived from preliminary analysis of data are indicated in Table 5. Institutional work in the context of sustainability adoption in construction is relevant and significant to document, as it would help firms, policymakers, and consultants identify purposeful actions to contribute to sustainability transitions.

Table 5: Conditions enabling sustainable value propositions

Sustainable Value Proposition	Illustrative Categories (A condition: Enabler/Constraint)
Enabling adaptive reuse of existing buildings	Condition 1: Client's commitments to net zero targets
	Condition 2: Stringent demolition regulations
	Condition 3: Early involvement of structural consultants

Expected Contributions and Upcoming Work

The expected contributions of this research to the literature are twofold. First, by studying proactive organizations (Benn et al., 2006) in pursuit of sustainability interventions, we identify potential, yet unrealized value propositions and business model strategies for AEC organizations for accelerating sustainability impacts. Second, we identify the challenges arising from the value-creation process and from routinized practices at various levels (projects, organizations, fields) that even large, resourceful organizations face in creating and delivering sustainable value propositions in project settings. This understanding is significant because, without adequately identifying and addressing the resistance encountered, opportunities to advance sustainable business models, even in proactive organizations, may remain limited. Furthermore, as we study how organizations approach these challenges through an institutional lens, our analysis indicates that a strong connection exists between how institutionalized routines in the field constrain and how institutional work (Lawrence & Suddaby, 2006) by project stakeholders enables framing, creation, and delivery of a sustainable value proposition.

References

1. Ahn, Y.H., Pearce, A.R., Wang, Y. and Wang, G., 2013. Drivers and barriers of sustainable design and construction: The perception of green building experience. *International Journal of Sustainable Building Technology and Urban Development*, 4(1), pp.35–45.
2. Akadiri, P.O., 2015. Understanding barriers affecting the selection of sustainable materials in building projects. *Journal of Building Engineering*, 4, pp.86–93.
3. Allwood, J.M., Cullen, J.M., Carruth, M.A., Cooper, D.R., McBrien, M., Milford, R.L., Moynihan, M.C. and Patel, A.C., 2012. *Sustainable materials: with both eyes open* (Vol. 2012). Cambridge, UK: UIT Cambridge Limited.
4. Chandrasekar, A., Clark, S.E., Martin, S., Vanderslott, S., Flores, E.C., Aceituno, D., Barnett, P., Vindrola-Padros, C. and Vera San Juan, N., 2024. Making the most of big qualitative datasets: a living systematic review of analysis methods. *Frontiers in Big Data*, 7, p.1455399.
5. Darko, A. and Chan, A.P.C., 2017. Review of barriers to green building adoption. *Sustainable Development*, 25(3), pp.167–179.
6. Djokoto, S.D., Dadzie, J. and Ohemeng-Ababio, E., 2014. Barriers to sustainable construction in the Ghanaian construction industry: Consultants' perspectives. *Journal of Sustainable Development*, 7(1), pp.134–143.
7. Du Plessis, C., 2007. A strategic framework for sustainable construction in developing countries. *Construction Management and Economics*, 25(1), pp.67–76.
8. Durdyev, S., Ismail, S., Ihtiyar, A., Bakar, N.F.S.A. and Darko, A., 2018. A partial least squares structural equation modeling (PLS-SEM) of barriers to sustainable construction in Malaysia. *Journal of Cleaner Production*, 204, pp.564–572.
9. Gan, X., Zuo, J., Ye, K., Skitmore, M. and Xiong, B., 2015. Why sustainable construction? Why not? An owner's perspective. *Habitat International*, 47, pp.61–68.
10. Glass, J. and Dainty, A.R.J., 2011. The sustainable construction business: a missing ingredient in creating a sustainable built environment? *International Journal of Construction Management*, 11(2), pp.1-18.
11. Hwang, B.G., Shan, M. and Lye, J.M., 2018. Adoption of sustainable construction for small contractors: Major barriers and best solutions. *Clean Technologies and Environmental Policy*, 20(10), pp.2223–2237.
12. Lawrence, T.B. and Suddaby, R., 2006. Institutions and institutional work. In: S.R. Clegg, C. Hardy, T.B. Lawrence and W.R. Nord, eds. *The Sage handbook of organization studies.* 2nd ed. London: Sage, pp.215–254.
13. Maqbool, R., Arul, T. and Ashfaq, S., 2023. A mixed-methods study of sustainable construction practices in the UK. *Journal of Cleaner Production*, 430, p.139087.
14. Schaltegger, S., Lüdeke-Freund, F. and Hansen, E.G., 2012. Business cases for sustainability: the role of business model innovation for corporate sustainability. *International journal of innovation and sustainable development*, *6*(2), pp.95-119.
15. Strauss, A. and Corbin, J., 1990. *Basics of qualitative research: Grounded theory procedures and techniques.* Newbury Park, CA: Sage.
16. Stubbs, W. and Cocklin, C., 2008. Conceptualizing a "sustainability business model". *Organization & environment*, *21*(2), pp.103-127.
17. U.S. Environmental Protection Agency (EPA) (n.d.) *Green building*. Available at: https://www.epa.gov/smartgrowth/green-building (Accessed: 20 January 2026).
18. Webb, L., 2017. Online research methods, qualitative. *The international encyclopedia of communication research methods*, pp.1339-1346.
19. Yin, R.K., 1994. *Case study research: Design and methods*. 2nd ed. Thousand Oaks, CA: Sage Publications.