



The Costs and Benefits of Circularity in Building Construction

Project Overview

How can we identify incentives and regulatory instruments to foster the adoption of circular economy principles in the building construction industry?



Siqi Zheng

While adopting circular economy practices in the construction industry can help reduce greenhouse gas emissions, many barriers exist to adoption – and current perceptions of, and willingness to pay for, circularity have yet to be quantified. This project, led by MIT Professor Siqi Zheng (Urban Studies and Planning, Center for Real Estate), Principal Research Scientist Randolph Kirchain (Concrete Sustainability Hub), Principal Research Scientist Fabio Duarte (MIT Senseable City Lab, Center for Real Estate), and PhD student Juliana Berglund-Brown (Building Technology Program), featured a survey of construction industry stakeholders to understand perceptions of circularity in the construction industry, characterize uncertainties and risks, and identify economic incentives and opportunities that could accelerate adoption.



Randolph Kirchain

The project aimed to identify incentives and regulatory instruments to foster the adoption of circular economy principles. The research team's methodology followed an iterative surveying process, beginning with exploratory interviews with industry experts, literature review and survey development, pilot survey dissemination, final survey dissemination, and data analysis and interpretation. Fifty-eight stakeholders filled out part of the survey, and forty-two stakeholders completed the majority of questions.



This project aligns closely with the MCSC's Circularity pathway.



Findings & Outcomes

Developers, architects, engineers, and investors are interested in understanding the practical applications of circularity in building practices, but the perceived high cost and risks present significant hurdles.

This survey revealed an interest among all stakeholders, including developers, architects, engineers, and investors, in understanding the practical applications of circularity in building practices. The majority of respondents had previously heard of circularity, and an average across all responses indicated a perceived cost premium of ~66% and an average time premium of 46% when adopting circular practices. Respondents demonstrated a readiness to accept increased construction costs for significant reductions in embodied carbon. Real estate developers are willing to pay an average premium of 10% for construction costs if there's a minimum embodied carbon reduction of 53%. Design and construction professionals and material suppliers were also surveyed to assess the willingness-to-pay for their services and processes.

While a majority expressed interest in circular practices, the perceived high cost of deconstruction, increased construction time, and perceived risks of new practices present significant hurdles. Survey results demonstrated where, throughout project delivery, stakeholders perceived there to be enablers and bottlenecks. When asked what would make them consider adopting circular practices, respondents would primarily be influenced by regulatory demands, client requirements, and net-zero goals.

The results of the survey begin to characterize the economic landscape of what is needed for a circular transition in the built environment.

Journal Publication: *npj Urban Sustainability*

The team's work was published in *npj Urban Sustainability*, a *Nature*-family journal, in an article entitled "Stakeholders' perceptions of and willingness to pay for circular economy in the construction sector." It was co-authored by Juliana Berglund-Brown, Akrisht Pandey, Fabio Duarte, Raquel Ganitsky, Randy Kirchain & Siqi Zheng.

Their work was also featured in MIT News.

Opportunities for Implementation

Circular practices are ripe for implementation in industry. A number of policies have emerged to promote construction circularity efforts, including the EU Circular Economy Action Plan¹. There is also evidence of commercial interest in the circular economy, as a number of technologies have come to market that facilitate circular construction methods across new build, renovation, and demolition practices, in addition to emerging digital platforms². Additionally, several non-governmental

¹ European Commission. Circular economy action plan. https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en (2020).

² Nußholz, J., Çetin, S., Eberhardt, L., De Wolf, C. & Bocken, N. From circular strategies to actions: 65 European circular building cases and their decarbonisation potential. *Resour. Conserv. Recycl. Adv.* 17, 200130 (2023).

organizations focused on green building certification incentivize circularity, including LEED and BREEAM Certification. This promising level of interest, in addition to existing technologies, indicate a nascent market for circularity in the built environment – but practices have yet to be adopted at scale.

In general, industry can implement this research by beginning to integrate circular practices such as reuse and design for disassembly into their business strategies. Several business model types emerge such as resource recovery systems, product-as-a-service models, product life extension strategies, and various sharing platforms that would aid in establishing a circular economy. That being said, available circular practices vary all along the construction value chain and different questions arise for each actor. Additionally, each project delivery phase lends itself to different opportunities for value creation as demonstrated in Figure 2.

Supporting Figures

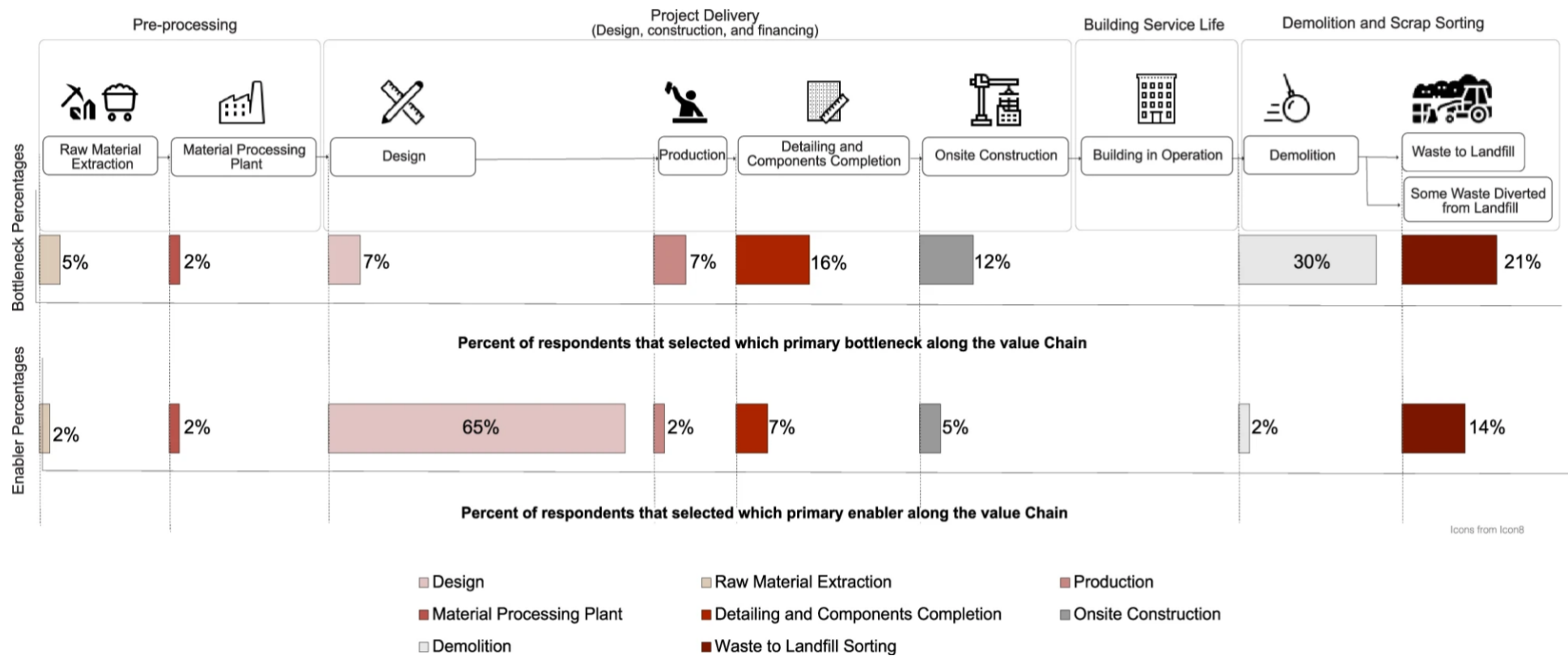


Figure 1. Perceived bottlenecks and enablers to circularity along the value chain.

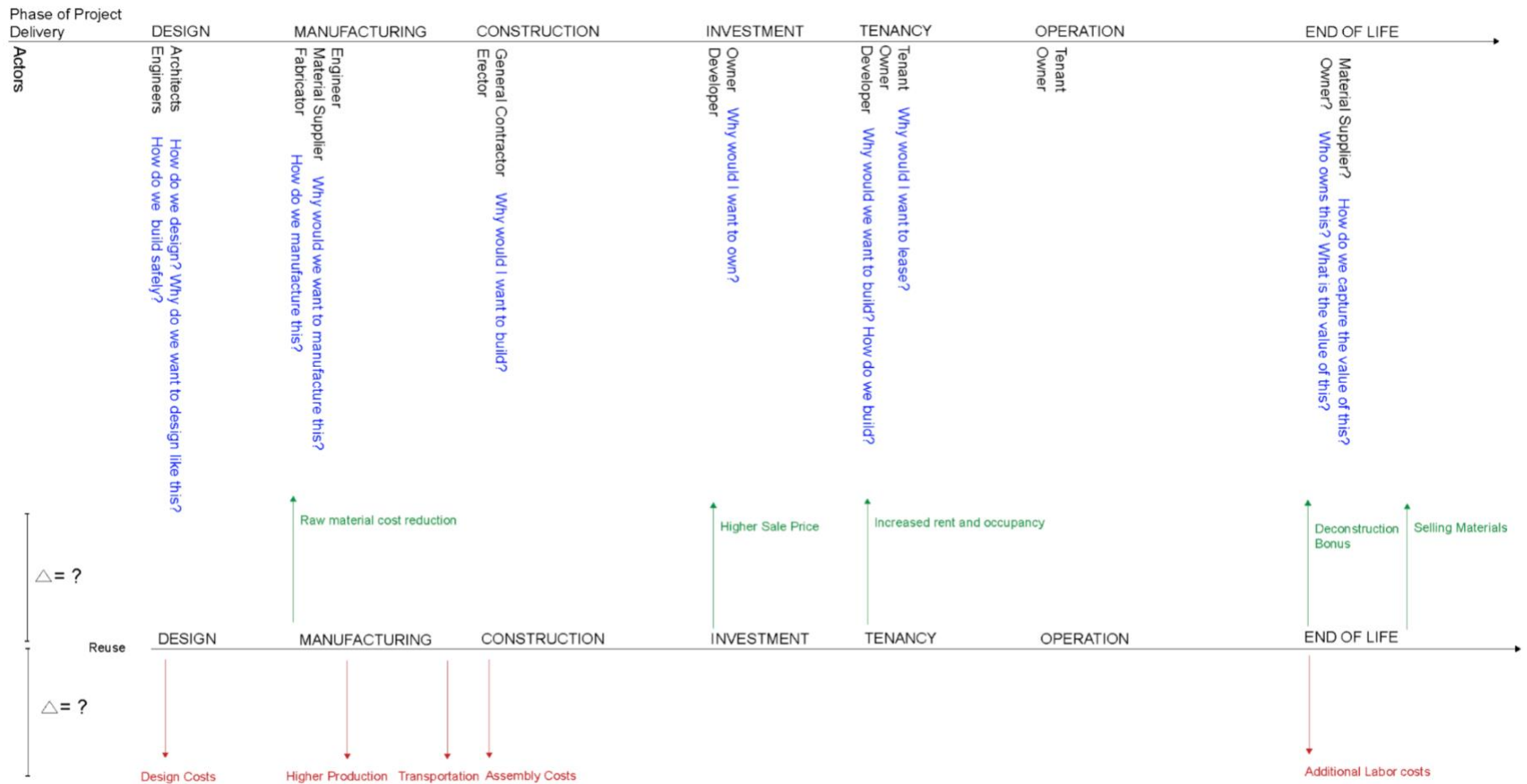


Figure 2. Potential questions and opportunities for value when adoption circular practices throughout project delivery.