Chapter 2
In-House Engineering as a Catalyst for Sustainable Innovation in Construction

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ABSTRACT

In-house engineering can be a powerful driver of innovation and sustainability in the construction industry. The authors examine the strategic choice between internalizing engineering services and outsourcing them and how it influences a firm's ability to innovate and meet sustainability goals. Integrating the four established theoretical perspectives (Transaction Cost Economics, Resource-Based View of the Firm, Dynamic Capabilities, and Absorptive Capacity), they develop a decision framework providing insights into the contexts and situations when in-house engineering adds the most value, becoming the preferred choice for construction firms. They start with an overview of industry trends, showing a clear shift from traditional outsourcing toward more integrated models as firms seek long-term competitive advantage. Then, they integrate decision criteria (cost, risk, innovation potential, sustainability, knowledge retention, and governance considerations) into a unified framework and illustrate them with case studies of major construction and engineering firms.

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INTRODUCTION

The construction industry faces mounting pressure to improve sustainability and innovation in project delivery. Construction and infrastructure projects contribute significantly to carbon emissions and resource consumption, making sustainable practices a growing priority (Oakland & Marosszeky, 2017). At the same time, innovation is increasingly recognized as vital to a company's competitiveness, yet the construction sector has historically lagged behind other industries in innovation performance (Blayse & Manley, 2004). Fragmented project delivery, characterized by siloed responsibilities and heavy outsourcing, has often been blamed for this lag (Gann & Salter, 2000). Many construction firms traditionally outsource substantial portions of design and engineering scope to external consultants, a practice rooted in specialization and risk aversion (Abdel-Rahman, Dokhan, & El-Dash, 2023). This "make-or-buy" decision, whether to perform engineering in-house or contract it out, is not merely operational; it is strategic and has far-reaching implications for a firm's innovative capacity and sustainability outcomes (Sinha, Osiyevskyy, & Radnejad, 2022).

In-house engineering ("make" approach) refers to a firm directly employing engineers to handle project design, planning, and technical tasks, whereas outsourced engineering ("buy" approach) refers to hiring external engineering consultants to perform those services. Historically, outsourcing was pursued for perceived cost efficiency and access to specialized expertise not available internally. By transferring design work to external parties, contractors could reduce fixed staffing costs and tap into a competitive market of engineering firms. However, over time, drawbacks of excessive outsourcing became apparent within the industry. Coordination difficulties, misaligned incentives, and loss of institutional knowledge often accompanied the outsourcing model (Blayse & Manley, 2004; Gann & Salter, 2000). Projects with complex, interdependent components often suffered from fragmented roles, designs optimized in isolation by external consultants that did not translate well to on-site construction realities, leading to costly changes or project delays. Additionally, outsourcing can incur hidden transaction costs in managing contracts, communications, and quality control that offset the apparent savings. As project complexity and the need for sustainable innovation have risen, many firms have begun to reconsider the balance between external and internal engineering capabilities.

Currently, an emerging shift is underway: forward-thinking construction companies are investing in in-house engineering teams as strategic assets to drive innovation and embed sustainability into projects from the outset. Integrating engineers within the contractor's organization can break down silos between design and construction, creating feedback loops for continuous improvement. When designers and builders work in tandem under one roof, sustainable design principles can be woven into