Shifting gears, shifting paradigms: Entrepreneurial considerations for construction robotic firms

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Extended Abstract

In the rapidly evolving organisational fields of construction robotics and digital fabrication (DFAB), the pace of technological advancement contrasts with the slow rate of adoption within the industry. This discrepancy raises critical questions regarding the factors influencing the integration of these innovations into construction practices. In response, entering its concluding phase, this doctoral study reexamines the seminal frameworks that Kangari and Halpin (1990) and Brown and Katz (2009) established. This project aims to uncover the complex dynamics that govern the adoption of construction robotics and DFAB technologies by embracing multiple research paradigms. This approach acknowledges the multifaceted nature of technological integration, suggesting that barriers to adoption extend beyond technical considerations to encompass a broader range of socioeconomic, organisational, and cultural dynamics.

For the past decade, DFAB research has predominantly focused on assessing technological feasibility (e.g., see Taha *et al.*, 2019; Ma *et al.*, 2020) and has been rooted in design science methodologies and demonstrator projects (Graser *et al.*, 2023). This focus is suitable for technologies with low readiness. However, as these technologies evolve, a compelling argument can be made from a broader analytical perspective. As such, this doctoral research project aims to explore the dynamics of innovation and its economic integration within the construction sector by weaving together insights from entrepreneurship, construction management, and socioeconomic factors. The distinctive core element of this study is its diverse methodological approach. This approach is crucial for challenging the convention that limits the discourse to technical utility and is done through three independent studies (see Figure 1).

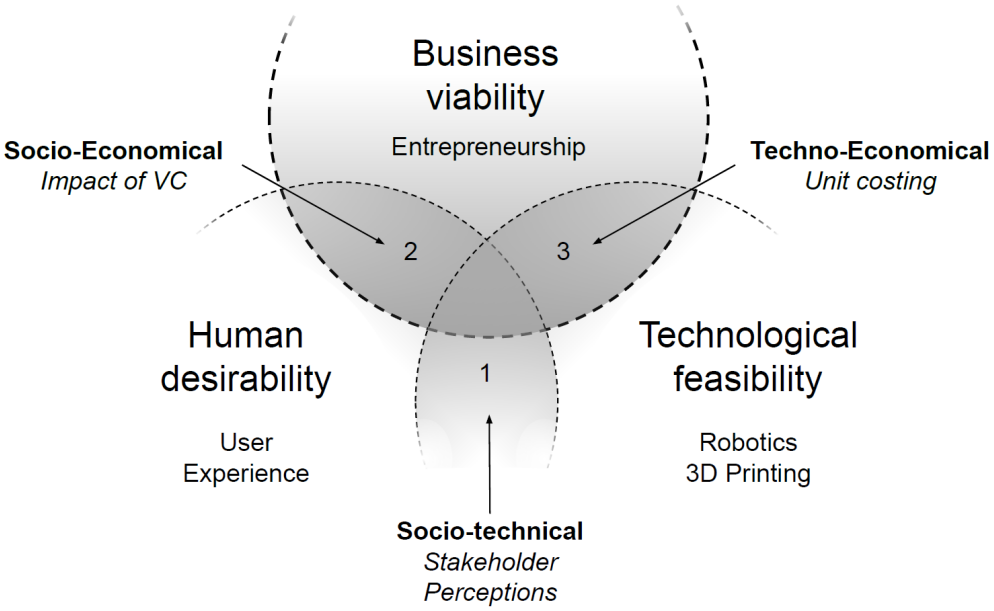

Figure 1. Overview of the doctoral research project and its three involved studies.

At the outset, a significant gap in the existing literature was identified: the limited understanding of construction professionals' perceptions of robotics and DFAB. To address this, the first study leverages a mixed-methods approach, combining qualitative interviews (n=5) with quantitative surveys (n=2) to gain insights into stakeholders' perceptions (N=161). Based on binary logistic regression, this approach yields insights into robot design, which in turn offers implications for usability, functionality, and job security (Walzer *et al.*, 2022). These insights mark a progressive step in understanding the assimilation of construction technology into industry practices from the perspective of stakeholder perceptions.

In the second study, the doctoral project focused more on the socioeconomic landscape, specifically the role of venture capital (VC) in the construction robotics sector. This study used a qualitative approach based on semi-structured interviews (N=127) and an abductive thematic analysis. Employing the analytical lens of institutional logic, this study highlights the economic considerations of technology adoption and identifies the alignments and misalignments between founders and investors (Walzer *et al.*, 2024a). However, such divergences could benefit industry innovation and are discussed as potentially leading to new practices that require more longitudinal studies.

Finally, the third study includes a more comprehensive economic approach to the role of production uncertainty by employing quantitative methods that enrich this doctoral research. This study combines scenario, sensitivity, and uncertainty analyses, mainly focusing on concrete 3D printing, to assess the potential for economies of scale and cost efficiency (Walzer *et al.*, 2024b). This exploration contributes to the economic viability of emerging production technologies and furthers the discussion of their economic feasibility and scalability.
In conclusion, this doctoral project significantly contributes to our understanding of the complex dynamics surrounding the adoption and integration of construction robotics and DFAB through its diverse topics and methodologies. It interlinks technological, socioeconomic, and institutional perspectives, offering a holistic framework for probing the

implications of these technologies in the construction industry. Through three independent studies, this research project enhances the comprehension of how construction technology innovations assimilate into industry practices, potentially highlighting their implications for the sector's future.

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