# Organisational actors' motivations and building performance traps: Evidence from case studies and modelling on interactions of reputation, identity and collaboration

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Buildings are estimated to be responsible for 37% of GHG emissions in the UK (CCC, 2014, p. 153; IEA & OECD, 2015). Despite recent innovations in design, materials, techniques and technologies, the UK's construction industry consistently fails to deliver energy efficient buildings (Palmer, Terry, & Armitage, 2016). There is ample evidence of a gap between performance estimated during design and the actual performance in operation (Zero Carbon Hub, 2014; Palmer et al., 2016). A performance gap is observed also for occupant well-being and indoor environmental quality (IEQ), as these often suffer from unintended consequences of narrowly focused energy policy (Davies & Oreszczyn, 2012; De Wilde, 2014; Shrubsole, Macmillan, Davies, & May, 2014). reviewed many Barriers to building performance acts at different steps of the building delivery, from briefing, to construction and operationalisation, and varying in nature from skills to communication and responsibilities (Zero Carbon Hub 2014). Yet, the root causes of these barriers and how they emerge from the wider social, economic and regulatory context of the building industry are unclear (Ryghaug & Sørensen, 2008). For policy formulation it is paramount to account for these emerging barriers and to avoid the siloed approach leading to unintended consequences, disjointed efforts and policy resistances (Davies & Oreszczyn, 2012; Shrubsole et al., 2014), and look at the built environment as a complex socio-technical system (Macmillan et al., 2014; Shrubsole et al., 2018).

Sorrell (2003) reviewed the main barriers to energy efficiency in the light of market failures, stressing the importance of bounded rationality of the actors involved in projects characterised by numerous stakeholders, complex interactions, problematic collaboration and integration (Bresnen & Marshall, 2000; Cole, 2011; Egan, 1998; Fedoruk, Cole, Robinson, & Cayuela, 2015; HM Government, 2011; Killip, 2013; Latham, 1994; Pryke, 2017; Sorrell, 2003; Wolstenholme, 2009; Zero Carbon Hub, 2014). Many collaboration-shaping factors, such as alignment of incentives, mutual trust and commitment strongly depend on the organisations involved in the project, their motivations and approaches (Akintoye & Main, 2011; Hillebrandt, 2003; Robertson & Mumovic, 2013). These motivations are generally triggered externally, for example through contractual arrangements, or are deeply rooted in the organisational actors' identity and mental models (Clark, Gioia, Ketchen, & Thomas, 2010; Corley & Gioia, 2004; Klein & Sorra, 1996; Zimmermann, 2011). As yet though, the role of these organisational factors in the performance gaps in construction has received little attention (Boyd & Schweber, 2012; Brown & Phua, 2011; Gluch, 2009; Hietajarvi & Aaltonen, 2017).

In summary, despite ample evidence about the existence of a building performance gap, we need a deeper and systemic understanding of the drivers of this gap and how it is rooted in the motivations of the main stakeholders. Thus, the research explores, through case study interviews, how actor motivations in construction teams can shape collaboration processes and influence building performance outcomes. The study applied a System Dynamics approach focusing on building projects as a fundamental unit of analysis of the building stock performances, as it has been widely used in project management for generic industrial and production processes (Cooper, 1980; Ford & Sterman, 1998; Lyneis & Ford, 2007; Rahmandad & Hu, 2010; Rodrigues & Bowers, 1996) as well as in the construction industry (Lee, Peña-Mora, & Park, 2005; Lyneis & Ford, 2007; Parvan, Rahmandad, & Haghani, 2015; Wan & Kumaraswamy, 2014). Specifically, we used system dynamics modelling to identify performance traps, defined here as feedback mechanisms that can hinder project outcomes and building performance, and relate them to stakeholders' motivations and decision making.

The data set comprises 12 interviews of main actors (architects, engineering and commissioning consultants, contractors, clients, facility managers) involved in the delivery of 3 case study public building projects (office, hospital, school) with contract values varying between £ 35 and 80 million. The common characteristic of the cases is the stakeholders' commitment to performance quality, evidenced by the presence, in one of the case studies, of energy targets for the building in operation. Unlike design targets, these targets require a commitment to the building in use, reflecting the research focus on challenges and dynamics involved in the delivery of high performance buildings. Interviews were open and semi-structured to allow participants to recount their own stories and opinions drawn both from the specific project and their whole experience in the field. Information on organizational and management aspects was crossed with hard data about energy consumption and pollutants concentration collected by another part of the wider research team (Shrubsole et al., 2018).

Interview transcripts were first analysed through a thematic coding in NVivo and then through causal mapping in Vensim, where variables and connections were identified directly from the text and reported in the documentation of the variable (Luna-Reyes & Andersen, 2003; Turner, Kim, & Andersen, 2013). As a result, an articulated causal loop diagram (CLD) was produced from each interview, where feedback loops were identified, labelled, documented and counted in their recurrence across interviews and cases. A simplification process followed with a re-organisation by theme. A two-way comparison between themes identified in NVivo and those in the CLDs was performed, by different team members, to assess their general overlap. Differences or ambiguities were discussed and used to adjust the final CLDs. Finally, to explore some scenarios and test hypotheses, a simulation model was built and calibrated on the office case study, selected because of the unusual 3-year delay in contract sign-off. Quantification was based on extracts from the transcripts, consultation of construction industry experts, and information from the monitoring part of the research project (Amaratunga, Baldry, Sarshar, & Newton, 2002). Figure 1 shows the selected feedback loops used in the model to explain the observed behaviour.

The dynamics identified in the research explain: 1) how and why building quality declines in the first place: the *contractor's rapacity* loop drives the contractor to cut corners to adjust its margin profits, thus generating a *cascade effect* that reinforces downstream defects and delays; 2) how client and contractor can behave in relation to quality control: as the contractor compromises with quality, the *moral hazard* loop drives it to reduce the information shared with the client in fear of claims, whereas the *client's acquiescence* to avoid delays lessens its commitment to quality, thus tolerating flaws that would have been resolved more quickly if addressed earlier (therefore increasing the actual delay); 3) how client and contractor can collaborate for quality adjustments and project smoothing: when deliveries start to lag behind expectations, the *blaming vortex* loop exacerbates problems, which become harder to solve in an adversarial relationship; 4) the role of the client's performance targets to assess the delivered quality: as long as the client remains committed to performance targets, averting the *target erosion* trap, delays and defect fixes to meet targets create extra efforts and costs to the contractor (*cost boomerang*); 5) how contractors can deal with the performance gaps spotted by the client: the sunk costs derived by rework delays increase tension and reduce profitability, disincentivizing the contractor to fix problems (*contractor's indolence*).

Concerning stakeholders' motivations and decision making, CLDs and simulations highlighted the relevance of *transparency* and *open dialogue* for quality control and collaboration since an honest management of expectations and timely collaborative actions, such as resources and deadlines extensions, can significantly change project outcomes (Figure 2). Another insight is the trade-off between priorities in organisations, whereby the contractor's predictable opportunistic behaviour is sometimes overlooked by the client due to time and cost constraints, neglect of targets and internal disarray. The case studies showed that, although explicit energy operational targets can improve performance, they also increase the scrutiny of the overall quality, thus aggravating the usual challenge of meeting project targets and deadlines. In this sense, if it is true that general actors' economic drivers are generally predictable (Sorrell, 2003), there are relevant differences on how organisations approach projects, their perceived value in specific outcomes and the market image they pursue. The paper contributes to the literature by providing an initial step of integration between project and building performance and their underlying causes as emerging from actors' motivations, contractual incentives, organisational identities, and reputation (Brown & Phua, 2011; Zimmermann, 2011).

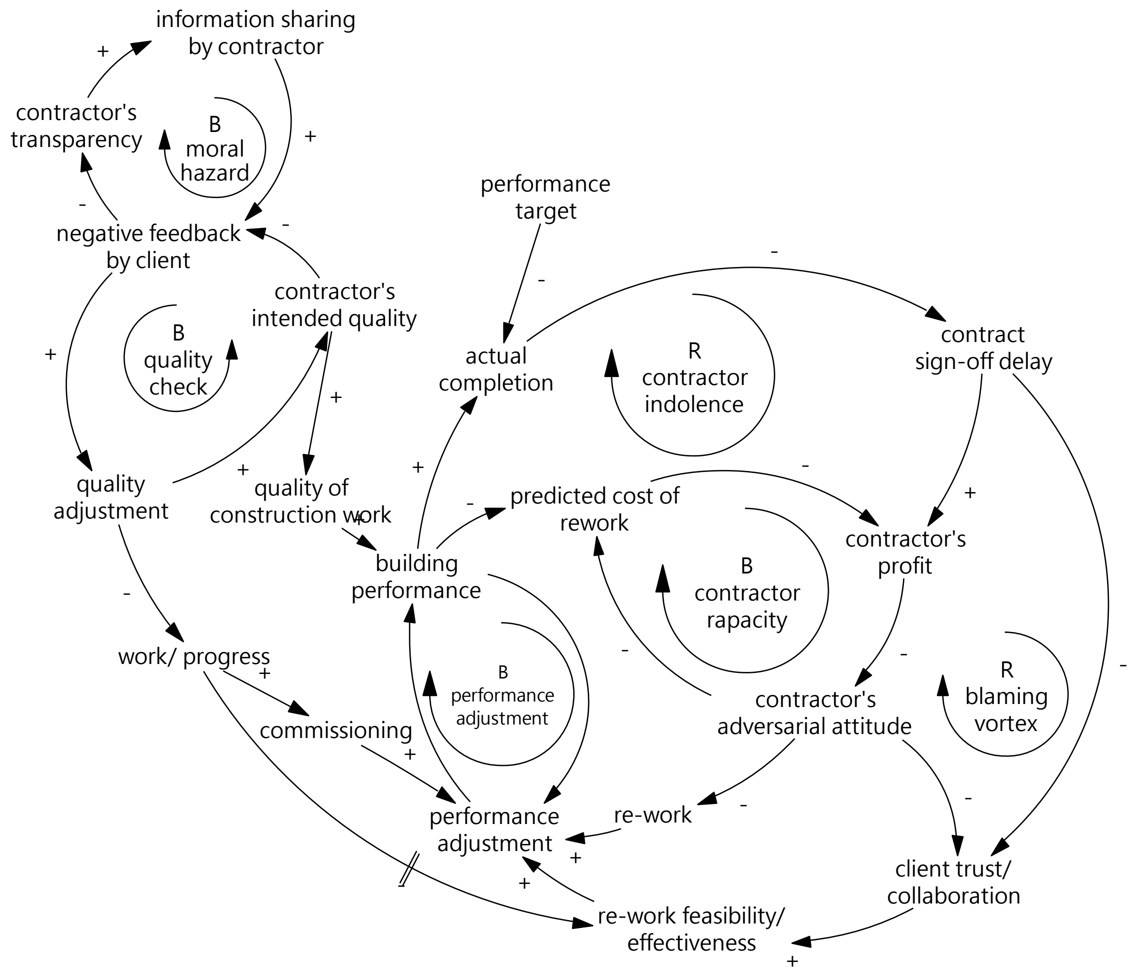


*Figure 1: CLD of the simulation model for the office case study.*

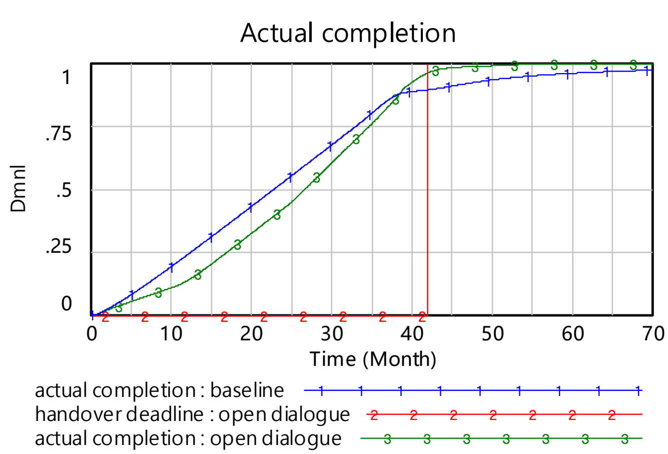


*Figure 2: Run comparison between the actual completion progress of baseline scenario (line1, blue) and the open dialogue scenario (line 3, green). Line 3 is the handover deadline that in the 'open dialogue' scenario is postponed by 6 months.*

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