PLEASE CITE THIS PAPER AS

“Wang, Zilun, Qinghua He, Giorgio Locatelli, Ge Wang, and Yang Li. "Exploring Environmental Collaboration and Greenwashing in Construction Projects: Integrative Governance Framework." Journal of Construction Engineering and Management 149, no. 11 (2023): 04023109.”

Exploring environmental collaboration and greenwashing in construction projects: An integrative governance framework

Zilun Wang[1], Qinghua He, Ph.D.[2], Giorgio Locatelli, Ph.D.[3], Ge Wang, Ph.D.[4,*], Yang Li[5]

Abstract

Environmental collaboration between organizations involved in construction projects enables the efficiency of environmental management to gain environmental sustainability. Yet, in many projects, this collaboration is gamed promoting contractor greenwashing behavior, thereby diminishing the effectiveness of environmental management. What is unclear are the underpinning mechanisms to concurrently increase environmental collaboration and decrease contractor greenwashing behavior in construction projects. We used an integrated theoretical framework based on social exchange theory and transaction cost economics to evaluate the potential linear, curvilinear, and combined influence of inter-organizational trust and formal contracts on environmental collaboration and contractor greenwashing behavior. Drawing evidence from questionnaire surveys, we find that two categories of inter-organizational trust yield positive impacts on environmental collaboration and different curvilinear impacts on greenwashing behavior. Two categories of formal contracts exert an inverted U-shaped effect on environmental collaboration and heterogeneous effects on greenwashing behavior. We also find that formal contracts negatively moderate the effects of inter-organizational trust on environmental collaboration, and inter-organizational trust negatively moderates the impact of formal contracts on greenwashing. We provide novel insights into the inter-organizational governance mechanisms regarding greenwashing in construction projects relevant for construction managers concerned with the environmental "efficiency-effectiveness".

Keywords: Environmental collaboration; Greenwashing behavior; Inter-organizational trust; Formal contracts; Social exchange theory; Transaction cost economics

---

[1] Ph.D. Candidate, School of Economics and Management, Tongji Univ., Shanghai 200092, China; Visiting scholar, School of Management, Politecnico di Milano, Milano 20156. Email: zylenw97@tongji.edu.cn

[2] Professor, School of Economics and Management, Research Institute of Complex Engineering and Management, Tongji Univ., Shanghai 200092, China. Email: heqinghua@tongji.edu.cn

[3] Professor, Politecnico di Milano, Milano 20156. Email: giorgio.locatelli@polimi.it

[4] Associate Professor, College of Public Administration, Huazhong Agricultural University, Wuhan 430070, China. ORCID: https://orcid.org/0000-0001-5417-6819, Email: ge_wang@yeah.net

[5] Ph.D. Candidate, School of Economics and Management, Tongji Univ., Shanghai 200092, China; Department of Civil and Environmental Engineering, University of Maryland, MD 20742, USA. Email: leon@umd.edu

* Corresponding author

Introduction

Construction project delivery is responsible for enormous resource consumption and greenhouse gas emissions (Wang et al. 2022a), imposing a severe environmental sustainability challenge. Project stakeholders are increasingly concerned with environmental performance (Green and Sergeeva 2019). Environmental performance refers to the outcomes of environmental management aiming to protect the environment (Yusof et al. 2020). An increasing body of literature evaluated environmental performance from two managerial dimensions: efficiency and effectiveness (Zhan et al. 2022). Efficiency means "*producing as many outcomes as possible with specific resource consumption,*" while effectiveness means "*the achievement of the final objectives*" (Hu and Liu 2018 p. 783). The project team hence assumes greater responsibility for delivering an environmentally efficient and effective construction project (Zhan et al. 2022).

Construction projects are vehicles of change, whereas the agents of change are the organizations involved (Musawir et al. 2020). The organizations' representatives, brought together under the project team, carry on these collaborative activities (Denicol et al. 2021). Environmental performance largely depends on environmental collaboration between the organizations delivering the projects (Li et al. 2022). Paulraj et al. (2014) defined environmental collaboration as *"cross-organization collaborative activities which exceed the traditional scope of organizations' tasks to pursue the environmental sustainability agenda"* (p. 6990). Previous literature has identified the following aspects of environmental collaboration: 1) frequent communication regarding environmental tasks (Zhao et al. 2021); 2) participation in others' environmental activities through construction charrette or other channels (Homayouni et al. 2021); 3) resource sharing towards green construction technology (Li et al. 2022); and 4) providing technical or financial support (He et al. 2022). Environmental collaboration increases the efficiency of environmental management among the project team, including promoting a shared environmental goal and developing more efficient environmental management routines (Li et al. 2022; Yang 2017 p. 307).

Environmental collaboration has both positive and negative aspects. While positive aspects are apparent, the discussion about negative aspects (the subject of this paper) is subtler. Literature increasingly cautioned about the potential negative consequence of collaboration (Villena et al. 2011; Zhou et al. 2014). Zhou et al. (2014) argued that collaboration could harm performance by creating pressure to reciprocate with partner organizations. Villena et al. (2011) posited collaborative inter-organizational relationships could cause relational inertia that hinders organizations' ability to meet goals. Galvin et al. (2021) indicated that collaboration between organizations involved in construction projects could cause opportunism. Although highly collaborative organizations can work empathetically and be supportive, organizations may be "*reluctant to act according to conscience*" (Tangpong et al. 2010 p. 410).

Particularly relevant is the opportunism of contractors, who, from a principal-agent perspective, are the agents in construction projects (Zardkoohi et al. 2017). If contractors struggle to achieve the expected investment return, construction projects are more prone to opportunism, even in a collaborative context (Galvin et al. 2021). Therefore, contractor greenwashing behavior, one of the typical environment-related opportunism, attracted much attention from academics and practitioners (He et al. 2020; Johnsson et al. 2020). Contractor greenwashing behavior refers to *"false communication that misleads project stakeholders to form positive beliefs about contractors' environmental performance"* (He et al. 2022 p. 2). Wang et al. (2018) suggested that the symbolic deployment of the project environmental management system is one common form of greenwashing. Yang (2017) found that one contractor of a megaproject exploited manipulated construction-site pictures to feign compliance with the waste management directives, with no substantial actions to organize the randomly piled construction waste (pp. 122-133). Contractor greenwashing behavior can mislead other organizations' judgments about the actual environmental performance (Handley et al. 2019). This interferes with project managers making accurate environmental management decisions. Contractor greenwashing behavior hence decreases the effectiveness of the environmental management (Johnsson et al. 2020).

It is, therefore, urgent to establish the underpinning mechanisms to increase environmental collaboration and decrease contractor greenwashing behavior concurrently. In this context, there are three relevant research gaps. First, existing literature independently examined the approaches to strengthening environmental collaboration and mitigating greenwashing behavior (Paulraj et al. 2014; Wu et al. 2020). Galvin et al. (2021) suggested that we need a combined governance perspective that focuses on both. Second, the negative implications of inter-organization collaboration are under-researched; e.g., Murtha et al. (2011) called for more awareness of the opportunism hidden in inter-organization collaboration. Last, there are scarce empirical guidelines to mitigate greenwashing behavior in construction projects. Extant corporate-related research has yielded insights into the mitigating role of external institutions on greenwashing behavior (Lyon and Montgomery 2015; Testa et al. 2018). However, construction projects are characterized by temporary and specific team structures (Braun et al. 2013). The project team comprises multiple organizations with different goals, priorities, cultures, etc., (Bakker 2010). To a large extent, inter-organizational relationships shape contractors' decision-making (Musawir et al. 2020). Therefore, the existing literature is insufficient to study and mitigate greenwashing behavior in construction-project contexts.

We thus focus on the inter-organizational governance of increasing environmental collaboration and decreasing contractor greenwashing behavior. Musawir et al. (2020) identified inter-organizational governance as a framework for creating an internal institutional context based on inter-organizational interactions in project-related research (p. 9). We examined inter-organizational governance with a novel theoretical framework leveraging social exchange theory (SET) and transaction cost economics (TCE). Specifically, we integrated the social-mechanism factor (i.e., inter-organizational trust) from SET and the economic-mechanism factor (i.e., formal contracts) from TCE. SET posits that bilateral relationships stem from a relationship-based willingness of the organization to affirm the other organization's abilities and accept their vulnerability, which is inter-organizational trust (Nee et al. 2018). Such relationships with reciprocal intention can serve the valuable function of collaborative activities (Wang et al. 2020b). However, greenwashing behavior originates from organizations' decision-making based on economic calculations (Truong and Pinkse 2019). Social exchange theory is inadequate to investigate the influence of inter-organizational interactions comprehensively. Therefore, we apply TCE, which is functional to our problem-solving. TCE posits that formal contracts, written contracts involving formal terms to stipulate economic-related responsibilities and obligations of organizations (MacCormack and Mishra 2015), can safeguard against opportunism (Zhou and Xu 2012). We also explored the combined effect of inter-organizational trust and formal contracts on environmental collaboration and contractor greenwashing behavior. Prior literature presented disparate findings on whether combinations of inter-organizational trust and formal contracts benefit (Cao and Lumineau 2015; Wang et al. 2020b). Hence, we investigated whether project managers should combine social- and economic- mechanisms to enhance collaboration and mitigate greenwashing. Thus, this study addresses the following research questions:

RQ1: How do inter-organizational trust and formal contracts individually influence (a) environmental collaboration and (b) contractor greenwashing behavior?

RQ2: Does the combined utilization of inter-organizational trust and formal contracts affect (a) environmental collaboration and (b) contractor greenwashing behavior?

The rest of the paper is structured as follows. The subsequent section describes the theoretical foundations of environmental collaboration and greenwashing behavior, followed by the theoretical framework and hypotheses development. Then, we introduce a questionnaire survey for construction projects. The following articulates the data analysis process using hierarchical regression analysis. Finally, we provide discussion and research implications to strengthen environmental collaboration and mitigate contractor greenwashing behavior.

Literature review and Hypotheses development

Environmental collaboration and contractor greenwashing behavior

Construction project literature categorizes environmental practices in construction projects into three aspects: contractors' environmental tasks, owner and supervisor's environmental monitoring, and inter-organization environmental collaboration (EC) (Paulraj et al. 2014). Unlike the environmental tasks and environmental monitoring, which are dealt with by contracts or project management manuals (Yang 2017 pp. 16–20), EC refers to a set of extra cross-organization activities that signal a collaborative intention in implementing environmental tasks (Adomako and Tran 2022; Dangelico and Pontrandolfo 2015). A telling example of EC is the owner providing extra-contractual convenient conditions for contractors' waste disposal (He et al. 2022 p. 11). EC consists of frequent communications, engagement in others' activities, resource sharing, and technical or functional assistance beyond the organizations' scope of work (Yang 2017 p. 307). The benefits of EC include enhancing mutual understanding (Kitsis and Chen 2021), promoting shared environmental goals, developing the most integrated environmental solutions (Li et al. 2022), and motivating environmental technology innovation (Greco et al. 2021). Li et al. (2022) indicated that EC, as a social learning process, substantially motivates technology innovation for wastewater reuse systems (p. 3). Hence, EC can boost the efficiency of environmental management in construction projects.

EC also has a grim side: inter-organizational collaboration might promote opportunism (Galvin et al. 2021). (Heirati et al. 2016 p. 2). Contractors can leverage a cooperation-oriented atmosphere and symbolic collaborative commitment to seek self-interest goals with individual rationality (Noordhoff et al. 2011; Xue et al. 2017). EC can promote confusion about the division of environmental tasks (Xue et al. 2017), allowing the contractor to behave opportunistically. Among opportunism, the most relevant to environmental management is contractor greenwashing behavior (GWB), which is positive misleading communication accompanied by poor environmental performance (Delmas and Burbano 2011). A typical example of contractor GWB happened in the Zhengzhou-Wanzhou High-speed railway project that connects sixteen neighboring cities in central and southwestern China (Hubei Daily, 2018). After the regulatory authorities found the dust pollution practices, four contractors exploited social media to build fictional stories around green construction as opposed to implementing the rectification requirements (Lvsenanyang, 2019). GWB causes difficulty in pinpointing poor environmental performance, discouraging the effectiveness of environmental management (Kurpierz and Smith 2020; Tashman et al. 2019). The literature has investigated the mitigating effect of normative pressures (Testa et al. 2018) and government regulation ability (He et al. 2020), both from the perspective of external institutions. However, in the context of construction projects, inter-organizational relationships exert a significant influence on contractors' decision-making (He et al. 2021). There is limited understanding regarding inter-organizational governance in relation to contractor GWB.

An integrated theoretical framework

We leverage social exchange theory (SET) to introduce a social-mechanism factor, i.e., inter-organizational trust. SET postulates that multiple organizations establish positive inter-organizational social relationships through trust activities (Nee et al. 2018). Child and Faulkner (1998) define inter-organizational trust as *"the willingness of one organization to engage with others in the belief that other's activities are beneficial to the first organization, even* *under unguaranteed circumstances"* (p. 45). Trust is at the basis of unspecified obligation and reciprocity, which are essential elements of the social relationship exchange (Yan and Zhang 2020). Organizations tend to collaborate; otherwise, they might get penalized by social relationships (Cropanzano and Mitchell 2005). Also, mutual expectations accompanied by trust incentivize organizations to invest in exchange-specific cooperation (Paulraj et al. 2014). More specifically, among project teams, inter-organizational trust promotes pro-active and voluntaristic cooperation predicated on reciprocity norms (Feitosa et al. 2020). It is, therefore, reasonable to expect that inter-organizational trust is beneficial in enhancing EC (we will test this later as a hypothesis). Leveraging Galvin et al. (2021), we identified two distinct categories of inter-organizational trust: cognition-based trust (CT) and affect-based trust (AT). CT depicts beliefs about other organizations' competency and reliability based on assessment and existing knowledge. AT refers to emotional bonds with other organizations coming from mutual concern and long-term cooperation.

One of our research subjects, greenwashing behavior, stems from organizations' interactions based on economic calculations (He et al. 2020). We hence utilize transaction cost economics (TCE) to explore inter-organizational interactions with an emphasis on economic issues. TCE provides a solid foundation for advancing our understanding of the economic-mechanism factor, i.e., formal contracts. Transactions with uncertainty and asset specificity are prone to organizations' bounded rationality (Williamson 1979). In this case, formal contracts, written contracts with stipulations of promises or obligations and enforcement, are effective mechanisms to restrain exchange hazards (Yan and Zhang 2020). In line with Luo (2002), we explored two facets of formal contracts: contractual completeness (CC) and contractual obligatoriness (CO). CC rests on the extent of contractual elaborateness and explicitness, comprising terms specificity and contingency adaptability (Wang et al. 2022b). Term specificity delineates the extent to which a formal contract stipulates detailed environmental responsibilities and risk allocation (Lu et al. 2016). Contingency adaptability portrays how contracts contribute to the solution guide for unanticipated environmental emergencies and contingencies (Ning 2018). CO, on the other hand, emphasizes the enforceability and application embedded in written contract documents. This facet concerns the severity and binding force of disciplinary actions taken by the owner to prevent breaches and violations of other organizations' environmental obligations (Lu et al. 2016).

Hypotheses development

Fig. 1 presents the framework linking inter-organizational trust, formal contracts, environmental collaboration (EC), and contractor greenwashing behavior (GWB). In the previous sections, we introduced the concepts of social exchange theory (SET), cognition-based trust (CT), affect-based trust (AT), transaction cost economics (TCE), contractual completeness (CC), and contractual obligatoriness (CO). In the framework, we included "interaction terms" linked to RQ2 to investigate the combined use of inter-organizational trust and formal contracts.

[Insert Fig.1 here]

Inter-organizational trust and environmental collaboration

Drawing upon SET, we argued that inter-organizational trust positively influences environmental collaboration. SET suggests a high level of inter-organizational trust in construction projects represents a socially embedded project culture with a close connection (Galvin et al. 2021). Increasing trust enhances organizations' involvement in activities that guide relationship continuance. This relation-specific guiding principle enables each organization to pursue multilateral decision-making that can ultimately decrease transaction costs (Heide 1994). With construction projects proceeding, inter-organizational trust supports organizations in sense-making each other's resources, abilities, and management systems regarding environmental management. Sharing fine-grained information and knowledge increases relation-specific adaptation and collaboration across organizational boundaries (Tomlinson et al. 2020). CT in projects stems from the organization's evaluation of other organizations' previous project practices and current cooperative relationships (Yan and Zhang 2020). During the project teamwork, CT improves psychological safety, mitigates perceived risks, and increases willingness for managerial and technical knowledge (Tomlinson et al. 2020). AT promotes empathy across organizations, leading to voluntary actions where an organization is involved in benevolent initiatives toward other organizations (usually a contractor) (Dunn et al. 2012). We thus proposed the following research hypotheses:

H1a. Cognition-based trust is positively associated with environmental collaboration.

H1b. Affect-based trust is positively associated with environmental collaboration.

Inter-organizational trust and contractor GWB

Based on the literature discussed below, we developed the hypothesis that inter-organizational trust has a U-shaped relationship with contractor GWB. In the first paragraph, we explain why we hypothesized that "with low trust," an increase in trust can decrease GWB. In the second paragraph, we explain why we hypothesized that "with too much trust," increasing the trust has a negative effect: increasing GWB.

For two reasons, we hypothesized that increasing inter-organizational trust in "low trust settings" can mitigate contractor GWB. First, the organizational perspective of SET suggests that inter-organizational trust can bring available resources to contractors for truly improving environmental behavior. Implementing actions to increase environmental performance is a cost faced by the contractor (Tam et al. 2007). Therefore, the contractor sees a trade-off between environmental sustainability (which often has a long-term perspective) and short-term economic interests (Sydow and Braun 2018). The organizational perspective regards inter-organizational trust as one of the organizations' strategies to access shared resources via relation-oriented connections (Gulati and Sytch 2007). Such resources allow the contractor to focus on actual environmental performance instead of misusing opportunism for short-term economic interests. Second, the sociological perspective of SET suggests that inter-organizational trust helps shape informal power relations among project organizations. Sarhadi et al. (2018) indicated that informal power relations could promote "participative project management", emphasizing power distribution and improving project communication. This sharing of information and communication limits the possibility for a contractor to implement GWB because it would be easy for the other organization to spot inconsistency between the contractor's communication and the actual behavior.

For two reasons, we hypothesized that increasing inter-organizational trust in "high trust settings" can promote contractor GWB. First, excessive inter-organizational trust can invalidate the control mechanism of formal contracts. SET suggests that inter-organizational trust mainly strengthens organizations' resource exchange through informal relationships (Yan and Zhang 2020). The domination of excessive trust conflicts with the strict environmental controls and monitoring of formal contracts (Poppo and Zenger 2002). Consequently, the conflict curtails the validity of contractual controls, and contractor opportunism might not be detected. Second, SET indicates that excessive informal power from trust blurs the boundaries of responsibility among organizations (Sarhadi et al. 2018). These blurred boundaries can give the contractor some extra rights, which may exacerbate the information asymmetry between organizations involved in the project (Zhong et al. 2017). For instance, when environmental emergencies happen, the owner might "empower" the contractor to handle these emergencies due to excessive trust. This can enable the contractor to access this "opportunity" to address these issues to pursue short-term economic interests rather than considering the environmental sustainability of construction projects.

Combining the ideas presented in the two previous paragraphs, we hypothesized a U-shaped relationship between inter-organizational trust and contractor greenwashing behavior:

H2a. Cognition-based trust exerts a U-shaped influence on contractor greenwashing behavior.

H2b. Affect-based trust exerts a U-shaped influence on contractor greenwashing behavior.

Formal contracts and environmental collaboration

Following the SET and TCE literature listed below, we derived the hypothesis that formal contracts have an inverted U-shaped relationship with EC. In the first paragraph, we explain why we hypothesized that "with low formal contracts," increasing formal contracts positively affects EC. In the second paragraph, we explain why we hypothesized that "with too many formal contracts," increasing formal contracts can decrease EC.

We hypothesized that increasing formal contracts in "low formal contract settings" can promote EC for two reasons. First, formal contracts can mitigate inter-organizational conflicts and help boost organizations' knowledge exchange through stable partnership relationships (Mesquita and Brush 2008; Wang et al. 2022b). CC clarifies the environmental responsibilities, providing a clear managerial interface to regulate each organization's behavior (Abdi and Aulakh 2017). This interface promotes effective environmental management procedures, including monitoring, contingency adaptation, incentivizing, and dealing with violations (Yang 2017 pp. 77–79). Consequently, Multiple environmental procedures are conducive to establishing shared goals and lowering environmental routines' ambiguity (MacCormack and Mishra 2015; Wang et al. 2021). Second, owing to the safeguarding role of CO in curbing opportunism, the contractor is required to truly fulfill the environmental responsibilities (Jiang et al. 2013). Therefore, CO can motivate the contractor to proactively seek environmental collaboration, which helps the contractor minimize the input to align with the responsibilities stipulated in the contract (Lu et al. 2016).

We hypothesized that increasing formal contracts in "high formal contract settings" can mitigate EC for two reasons. First, the leading cause could be the adverse effect of rigidity. Construction projects are temporary endeavors where "unforeseen events are inevitable" (Cerić et al. 2021 p. 327). Environmental tasks in projects are characteristic of the uniqueness of diverse geographic appearances and structures in specific projects (Ibrahim 2016). When exceeding a specific range of completeness, environment-related terms in a contract contain too many requirements and alternatives. This can limit the flexibility of inter-organizational collaboration in addressing environmental issues (Wang et al. 2022b). In this regard, over-detailed environmental management procedures set out the responsibilities too clearly, thus leaving no space for cross-organization collaborative activities. Second, high enforceability and penalty intensity expose the contractor to overwhelming pressures to achieve environmental objectives. These pressures might cause intense conflicts between the owner and the contractor (Yang et al. 2017). Such conflicts discourage initiatives of sharing environmental managerial experience and techniques (Dervin 1998). Engaging these insights, we hypothesized an inverted U-shaped relationship between formal contracts and environmental collaboration.

H3a. Contractual completeness exerts an inverted U-shaped influence on environmental collaboration.

H3b. Contractual obligatoriness exerts an inverted U-shaped influence on environmental collaboration.

Formal contracts and contractor GWB

We hypothesized that CC and CO could exert a mitigation effect on contractor GWB. TCE posits that organizations can use formal contracts to curtail opportunism (Heide and John 1992). First, CC can deter opportunism by stipulating environmental duties, obligations, risk allocation, and alternative solutions toward environmental emergencies (Jiang et al. 2013). Specified and detailed environmental provisions help the owner effortlessly detect the violation. This consequently narrows the scope of contractor opportunism (Lu et al. 2016). For instance, atmospheric particulate matter requirements written in contracts specify the accurate threshold for contractors. In this vein, definite risk allocation and responsibility division can help pinpoint the responsible organization promptly. This can increase the probability of identifying GWB (Reuer and Ariño 2007). Therefore, a high level of CC can offer sufficient evidence for the third-inspection organization to form a fair judgment. Second, CO exerts a negative effect on opportunism. The obligatory enforceability of contract provisions enables contractors to carefully consider the negative consequences of implementing opportunism. Consequently, CO can significantly diminish the potential benefits of opportunism and mitigate contractors' motivation for GWB. Hence, we predicted the following hypotheses:

H4a. Contractual completeness is negatively associated with contractor greenwashing behavior.

H4b. Contractual obligatoriness is negatively associated with contractor greenwashing behavior.

The combined effect of inter-organizational trust and formal contracts

We then turn to the combined effect of inter-organizational trust and formal contracts on EC and contractor GWB. Regarding EC, we hypothesized that the higher the degree of formal contracts, the less beneficial the inter-organizational trust to EC is. This is because formal contracts could interfere with establishing relationship exchanges from the inter-organizational trust. As hypothesized, inter-organizational trust can promote EC by establishing a relationship exchange. However, the controlling nature of formal contracts may alienate informal reciprocal relationships. In an inter-organizational relationship, trust operates as a self-enforcing mechanism and moral binding, which helps boost the relationship exchange. However, increasing CC and CO tend to signal that "other organizations are neither trusted nor trustworthy without formal controls" (Ghoshal and Moran 1996 p. 24). This exerts an adverse effect on the formation of collaborative intentions. In project settings, temporary partnership relationships exist (Cerić et al. 2021), and environmental protection tends not to serve as the primary project goal (Wang et al. 2020a). Too much attention to the formal control of environmental issues will likely drive a wedge into the trust-collaboration path. Thus, among the above arguments, we predicted:

H5. An increase in formal contracts discourages the positive relationship between inter-organizational trust and environmental collaboration.

Regarding contractor GWB, we hypothesized that the increase in inter-organizational trust would encourage the mitigating role of formal contracts. It is because that inter-organizational trust can ease the contractor's pressure to achieve environmental compliance. Formal contracts with high CC and CO curb contractor GWB and increase the contractor's input to truly pursue environmental sustainability (Lu et al. 2016). Hence, formal contracts pressure the contractor considerably, which may negatively affect inter-organizational relationships (Williamson 1991 pp. 271–273). Inter-organizational trust can create a collaborative atmosphere due to relation-oriented exchange. This atmosphere can help the contractor effortlessly and effectively fulfill their environmental responsibilities.

Consequently, inter-organizational trust can mitigate the contractor's motivation to greenwash. Kurpierz and Smith (2020) suggested that pressures and opportunities are essential for organizations to rationalize opportunism. The embeddedness of trust within formal contracts can further relieve contractors of the pressure to undertake environmental tasks when the contract can limit the opportunity. We thus predicted the following:

H6. An increase in inter-organizational trust encourages the negative relationship between formal contracts and contractor greenwashing behavior.

Research methods

Sampling and data collection

Our empirical investigation leveraged survey data from 586 Chinese project practitioners (including owners, general contractors, subcontractors, and supervisors). These practitioners were knowledgeable about environmental practices in construction projects. We administered the survey between March and June 2020, snowballing to access a representative sample (Preacher and Hayes 2008). We asked respondents to complete questionnaires based on their experience in a recent construction project. We received 903 questionnaires through an online survey system. We followed two criteria to exclude invalid samples. First, we screened out questionnaires within a 200-second completion time (N = 261). Second, we eliminated questionnaires in which respondents reported insufficient knowledge of project environmental practices (N = 56). We set an extra question to investigate respondents' familiarity with project environmental practices, "To which extent do you know the environmental practices of the selected construction project". Eventually, we left 586 valid questionnaires for further analysis. As illustrated in Table 1, most respondents occupy manager and professional engineer positions (75.8%).

[Insert Table1 here]

Questionnaire development and measurement

Following Zhou and Xu (2012), we conducted three processes to develop the final questionnaire. First, we compiled an initial pool of items based on theory and a thorough review of peer-reviewed literature. We then contextualized these items with project environmental practices. Second, we conducted semi-structured interviews with 10 scholars and 8 practitioners. We inquired scholars and practitioners about three aspects of questions in semi-structured interviews: 1) their understanding of environmental collaboration and contractor greenwashing behavior; 2) their assessment and suggestions regarding the accuracy, consistency with project practices, and readability of items, and 3) their thoughts on our research questions. Based on these interviews, we refined our scale items by evaluating the accuracy, consistency with project practices, and readability of specific items. For instance, two experts suggested that "specific environmental funds" prescribed in the contract should be listed to facilitate respondents' understanding (Please see item CC3 in Table 2). Third, we finalized the questionnaire by performing a pilot survey. We invited the 8 practitioners who participated in the semi-structured interviews and another 22 well-experienced practitioners (recommended by 18 interviewees) to our pilot survey. We asked the 30 practitioners to complete the questionnaire derived from the first two processes. We calculated 1) Corrected Item-Total Correlation for each item and 2) Cronbach's α for each construct to evaluate item consistency. Each item's Corrected Item-Total Correlation and Cronbach's α were evaluated, indicating no item should be excluded (Wu et al. 2017).

We used six and three items to measure *contractual completeness* (CC) and *contractual obligatoriness* (CO). These nine items were derived from Luo (2002) and Liu (2017). CC assesses the extent to which environment-related agreements are specific, detailed, and contingent, while CO examines the enforceability of environmental terms. We adopted the measures of *cognition-based trust* (CT) and *affect-based trust* (AT) from McAllister (1995). Three items of CT capture the rational evaluation of other organizations' reliability and dependability concerning environmental issues. AT has three items describing the emotional attachment stemming from mutual care. The four environmental collaboration (EC) items were adapted from Paulraj et al. (2014). These reflect the extent to which project organizations are proactive in jointly solving environmental problems across organizational boundaries. *Greenwashing behavior* (GWB) items in our study manage to capture contractors' misleading environmental communication. Seven measurement items were drawn from the corporate-level literature (Testa et al. 2018) and adapted to project research. This paper applied a five-point Likert scale ("1" denotes "strongly disagree", "2" denotes "disagree", "3" denotes "neither agree nor disagree", "4" denotes "agree", and "5" denotes "strongly agree") criteria to measure each item. criteria to measure each item. As in Wu et al. (2017), we developed the final questionnaire in English and translated it into Chinese. Then we back-translated it into English to ensure conceptual equivalence. Table 2 provides full details of these measurement items.

[Insert Table 2 here]

Control variables

Our study included four control variables to control for several sources of heterogeneity at the project and society levels. First, Yang (2017 pp. 7–8) indicated that project delivery purpose can shape specific environmental guidelines and objectives. We thus controlled for *project type* (i.e., residential buildings, public buildings, municipal infrastructures, industrial projects, etc., see Table 1) to address this concern. Following Shinkle et al. (2021), we ran the whole regression models with project-type fixed effects to partially out the type variance. Second, we controlled for *project duration* because the time accumulation of cooperation is a factor in supporting trust and collaboration development (Zhong et al. 2017). Project duration was operationalized by the construction period ("< 12 months", “12-24 months”, “24-36 months”, and “> 36 months”). Third, we focused on the influence of *project size*, which reflects the project’s complexity. Complex projects are characteristic of the priority of environmental objectives (Wang et al. 2017) and are exposed to intricate contractual and non-contractual relationships (Cerić et al. 2021). We thus controlled for *project investment*: “< 50 million”, “50-100 million”, “100-500 million”, “500-1000 million”, and “> 1000 million” (The unit of investment is Chinese Yuan (CNY)). Finally, given our aim, we controlled for external institutions (He et al. 2020) using three items adapted from Wang et al. (2016) to control for *regulatory uncertainty* (RU), which captures the uncertainty regarding environmental policies and legal enforceability.

Social desirability bias and common method variance

A frequently raised issue concerning survey methodology is the social desirability bias (SDB) (Testa et al. 2018). Considering the negative nature of contractor GWB, our study utilized four remedies to deal with SDB. First, we adopted indirect questioning to enable respondents’ comfort in speaking the truth (e.g., highlighting project behaviors as opposed to contractors’ behaviors, using a third-person perspective) (Fisher 1993). Second, we required respondents to finish the questionnaires based on their most recent project. Third, we granted anonymity and confidentiality during the survey (Wang et al., 2017). Fourth, following Ozer (2011), our questionnaire instructed owners and supervisors to assess their partners’ (i.e., contractors’) GWB to mitigate self-rating bias. For instance, we required the contractor respondents to score “the project’s” GWB. We required owners and supervisors to score “the contractor’s” GWB (see GWB items in Table 2). Last, Kwak et al. (2021) concluded that social desirability does not contaminate the estimate of a causal relationship if it influences only one dependent variable (i.e., contractor GWB in our study). This further indicated that SDB was not a severe concern in our study.

As for nonresponse bias, we followed Armstrong and Overton (1977) to separate our sample into three groups in line with the completion time of the questionnaire (i.e., “200-300 seconds”, “300-600 seconds”, and “more than 600 seconds”), and we checked that there were not statically significant differences. To evaluate standard method variance (CMV), we performed two procedures referring to Podsakoff et al. (2012). Harman’s single-factor test indicated that the most prominent factor contributed 36.77% of the measurement variances. This result revealed no single dominant factor. Additionally, we conducted confirmatory factor analysis by adding CMV latent variables. The △RMSEA (i.e., change in Root Mean Square Error of Approximation) is a measure used to assess the impact of incorporating the CMV latent variables on the overall model fit (Podsakoff et al. 2012). ΔRMSEA here is 0.018 and below the recommended threshold of 0.05. As such, CMV is not a significant concern for this study.

Construct reliability and validity

This study utilized exploratory factor analysis (EFA) in keeping with Anderson and Gerbing (1988). We adopted

EFA because EFA serves as a preliminary step in survey-based research. EFA can assess item-construct relationships, helping us evaluate the reliability of items in measuring the intended constructs (Hurley et al. 1997). We also applied confirmatory factor analysis (CFA), a crucial technique in survey-based research. CFA can assess the overall fit of the measurement model and systematically evaluate the reliability and validity of the constructs (Hurley et al. 1997). First, we employed EFA to investigate nine items associated with the contract. As shown in Table S1, the Kaiser-Meyer-Olkin value and Bartlett test result indicated that the correlation coefficient was satisfactory for EFA requirements (Field 2013). The loadings of nine items were above the recommended threshold of 0.5, suggesting that these items were appropriately classified into two proposed constructs. We subsequently used EFA to analyze the trust construct and validated its appropriateness. We performed CFA to assess the measurement models with all multi-item constructs. The result showed that the measurement model fit the data satisfactorily: Root Mean Square Error of Approximation = 0.062; Normed Fit Index = 0.991; Relative Fit Index = 0.989; Root Mean Square Residual = 0.033; Goodness of Fit Index = 0.993; Adjusted Goodness of Fit Index = 0.991; Parsimonious Goodness of Fit Index = 0.776.

Additionally, we conducted a comprehensive item evaluation concerning internal consistency, convergent validity, and discriminant validity. The composite reliability (CR) and Cronbach's α values in Table 3 were above the 0.70 benchmarks, showing a good internal consistency (Fornell and Larcker 1981). The average variance extracted (AVE) for each construct was above 0.50 (Field 2013). Another indicator of item convergent validity is standardized factor loading (SFL) (Hair 2009). The SFL was higher than the threshold of 0.7 in our study (please see Table 2). An examination of Table 3 revealed that the square roots of the AVE values (i.e., the diagonal elements of this matrix) were larger than the correlations among all constructs (i.e., the off-diagonal elements). This offered strong evidence of discriminant validity.

[Insert Table 3 here]

Statistical models and analysis

We used hierarchical regression analysis to test hypotheses. The reasons we selected hierarchical regression analysis are as follows. First, hierarchical regression analysis is a robust and accurate technique for examining curvilinear relationships among variables (Ren et al. 2022). Second, hierarchical regression analysis permits the stepwise entry of variables based on the research framework (Li and Ning 2022). This facilitates specific hypothesis testing regarding linear, curvilinear, and combined influences. The incremental R-squared values derived from this method help quantify the additional variance explained by including variables. Third, hierarchical regression analysis offers an easily interpretable approach for the relationships we explored (Chatterjee and Hadi 2015).

We added variables stepwise in the hierarchical regression to test the newly-added variables' effect under the premise of controlling added variables (Wang et al. 2022b). Before that, we performed a test to validate whether the data displayed violations of outliers, normality, and other problems. The test results indicated that these problems do not exist, and our data were suitable for regression analysis. Since the basic reported analysis utilized an ordinary least squares (OLS) regression procedure with robust errors, we mean-centered the independent variables of trust and contract to eliminate the potential multi-collinearity problem (Aiken et al. 1991). All the variance inflation factor values were less than 7.5, indicating multi-collinearity was of limited concern (Chatterjee and Hadi 2015). When evaluating the significance of the U-shaped relationship, a large body of literature considered the significance of the coefficient of quadratic terms. However, Lind and Mehlum (2010) deemed it insufficient to establish a significant curvilinear relationship. Therefore, we adopted an extra two-step U-test approach through Stata 15.0 developed by Hanns et al. (2016). Step one is to examine whether the slope of the quadratic term is significantly steep at both ends of the data range. Step two is to ensure that the turning point (i.e., the vertex of the curve) is within the data range.

Results

This research investigated a series of models to show the explanatory power of each set of variables. We set Model 1-4 and Model 5-8 to target environmental collaboration (EC) and greenwashing behavior (GWB), respectively: Model 1 and 5 with control variables only, Model 2 and 6 with focal variables entered, Model 3 and 7 with quadratic terms included, and Model 4 and 8 with interaction terms added. Table 4 reports regression results for hypotheses validating. Curvilinear and combined effects are graphically represented in Fig. 2-5.

Linear and curvilinear effects of inter-organizational trust

H1a and H1b posited positive linear relationships between trust and EC. Model 2 shows significant positive coefficients of cognition-based trust (CT) ($\beta = 0.292$, $p < 0.001$) and affect-based trust (AT) ($\beta = 0.434$, $p < 0.001$), and their quadratic terms are of insignificance exhibited in Model 3. These findings support H1a and H1b. To examine H2a and H2b, Model 7 tested the effect of trust on GWB under a curvilinear relationship. The results suggest that the quadratic term of CT is significantly positive ($\beta = 0.096$, $p < 0.05$), while that of AT is significantly negative ($\beta = -0.365$, $p < 0.001$). Both two quadratic terms passed the U-test evaluation. This result indicates that the curve of CT would initially follow a negative slope and then turn to become positive, while that of AT shows the opposite trend, as in Fig. 2. The U-test finding can help pinpoint the vertex of the curve (Haans et al. 2016). These results show the existence of a U-shaped influence of CT with a vertex of 3.927 (Fig. 2 (a)) and an inverted U-shaped influence of AT with a vertex of 3.145 on GWB (Fig. 2 (b)), supporting H2a but no H2b.

More specifically, we have two more nuanced findings. First, Fig 2 shows that with an increase in CT and AT, GWB both sees a generally downward trend. CT and AT can respectively diminish GWB within a long-range (i.e., CT∈(low CT, 3.927) and AT∈(3.145, high AT)). Second, the increasing effect of CT on GWB appears at the high-level range (i.e., CT∈(3.927, high CT), while the increasing effect of AT on GWB appears at the low-level range (i.e., AT∈(low AT, 3.145).

[Insert Table 4 here]

[Insert Fig.2 here]

Linear and curvilinear effect of formal contracts

We examined H3a and H3b in Model 3, which predicted the inverted U-shaped relationships between contractual completeness (CC), contractual obligatoriness (CO), and EC. The significantly negative coefficient of the quadratic term of CO ($\beta = -0.109$, $p < 0.001$) and the significant slopes at both ends of the range jointly support H3b. Fig. 3 portrays this inverted U-shaped curvilinear influence (the vertex is at CO = 4.199). However, the figure for CC is not significant and does not support H3a. More specifically, the location of the parabolic vertex (shown in Fig. 3) offers more insights. Among a high-level range (i.e., CO∈(4.199, high contractual obligatoriness), EC experiences a downward trend with increasing CO. Additionally, H4a and H4b anticipated the negative effect of CC and CO on GWB. Model 6 supports a significantly negative effect of CO ($\beta = -0.168$, $p < 0.05$), whereas CC does not exhibit a significant linear effect. However, we do see evidence of the potential curvilinear effect of CO in Model 7 based on the positive and significant coefficient for the quadratic term of CO ($\beta = 0.131$, $p < 0.01$). The U-test evaluation further confirmed this U-shaped curvilinearity with the vertex of 4.213 (shown in Fig. 4). Consequently, these regression results support H4b, while H4a is unsupported.

[Insert Fig.3 here]

[Insert Fig.4 here]

The combined effect of trust and formal contracts

Models 4 and 8 showed the combined impacts of inter-organizational trust and formal contracts on EC and GWB. Regarding EC, we find that in Model 4, the interactions between CT and CC are significantly and negatively associated with EC ($\beta = -0.158$, $p < 0.05$). This finding partially lends support to H5a and shows a negative moderating effect. As illustrated in Fig. 5 (a), with CC switching from low level to high level, the amelioration effect of CT on EC decreases dramatically. The coefficients of other interaction terms in Model 4 are found insignificant. Regarding GWB, Model 8 suggests that only the negative combined relationship between CO and AT is significant ($\beta = -0.241$, $p < 0.05$). This indicates partial support for H6a. Fig. 5 (b) shows that the relationship between CO and

GWB becomes more strongly negative at a high level of AT, which can be deemed a negative moderating effect. Model 4 and Model 8 displayed adjusted R^2 of 67.4% and 29.7%, respectively. This is acceptable considering the nature of the cross-sectional design (Sarstedt and Mooi 2014 p. 211) and the fact that we focus on the relationships formed between variables rather than predicting (Moksony 1999 pp. 131–132).

[Insert Fig.5 here]

Robustness checks

We conducted three sensitivity checks to assess the empirical analysis's robustness. First, given that our dependent variables are the Likert-scale measure and many respondents rated 1 or 5 (i.e., the minimum endpoint or maximum endpoint) on EC and GWB, we applied the censored Tobit analysis as a severe test of our results. Censored Tobit analysis allows a better evaluation of the robustness of regression results with Likert-scale measures (Shinkle et al. 2021; Tobin 1958). Tobit regression results indicated that the regression results are robust and confirmation of hypotheses has remained stable. Secondly, because project investment may influence contractors' environmental practices (Xu et al. 2013), this paper conducted a grouped regression regarding project investment structure to test the sensitivity further. Following Wang et al. (2022a), we separated the sample into the state-invest group (N = 316) and non-state-invest group (N = 270) and performed OLS regressions, respectively. Tables S2 and S3 show that the results hold across diverse investment patterns, increasing confidence in our findings. Third, the descriptive statistics (Table 3) suggest that inter-organizational trust correlates significantly with formal contracts. Extant research also indicated the significant effect of contracts on trust among project organizations (Lumineau 2017; Yan and Zhang 2020). To correct for potential endogeneity of trust, we followed Poppo et al. (2016) and conducted an alternative analysis using a three-stage regression model. In stage 1, we regressed CT and AT against control variables, CC, and CO, to obtain the residual free from the contract effect. In stage 2, we utilized residual terms to indicate CT and AT and consequently regressed EC and GWB against these residual terms, contract-, and control-related variables. In stage 3, we created pertinent mean-centered quadratic and interaction terms and examined their effects. Table 5 illustrates similar results to those in Table 4, indicating that our results remain robust.

[Insert Table 5 here]

Discussions

This paper aims to investigate the individual (RQ1) and combined effect (RQ2) of inter-organizational trust and formal contracts on environmental collaboration (EC) and contractor greenwashing behavior (GWB). Table 4 illustrates the results of hypothesis validation. We discuss relevant implications and react to the proposed research questions using our findings and the literature. First, we discuss the nuanced findings related to RQ1 and RQ2. Second, we discuss the theoretical and managerial implications of this study.

The individual effect of inter-organizational trust and formal contracts (RQ1)

Regarding RQ1, the results exhibit the different effects of inter-organizational trust and formal contracts on EC and contractor GWB. Firstly, the results indicate that cognition-based trust (CT) and affect-based trust (AT) positively influence EC, supporting H1a and H1b. This finding is consistent with Cheng et al. (2016) that relational governance can promote process collaboration. We validated the role of inter-organizational trust in shaping "informal and proactive environmental management practices" in project settings. Although Silvius and Schipper (2020) deemed environmental sustainability as a strategic imperative to organizations, most of the discussions on projects are still focused on the iron triangle (Tam et al. 2007), leaving environmental sustainability less discussed. Such imperative and limited resources motivate project organizations to manage resource dependence by forming inter-organizational trust. This motivation consequently builds environmental collaboration and support for other organizations (Wang et al. 2018).

Secondly, the results suggest that CT exerts a U-shaped effect on contractor GWB, while AT exerts an inverted U-shaped effect, supporting H2a but not H2b. Unlike Wang et al. (2019), the results indicate the curvilinear effect of trust in analyzing opportunism. Here we discuss two more nuanced findings. First, GWB sees a generally downward trend with CT and AT increasing. This finding demonstrates that inter-organizational trust can mitigate contractor GWB in most cases. This corroborates that "trust counteracts the fear of opportunism" (Gulati 1995 p. 93). More specifically, this finding is inconsistent with Stevens et al. (2015), which concerned the detriment of "excessive trust". The positive impact of AT on GWB within a range of high AT signifies the beneficial role of affectional bonds in governing environmental issues. Villena et al. (2019) proposed that AT contributes to longer-lasting inter-organizational relationships, extending beyond a single construction project. This finding should be further interpreted in light of our research context (i.e., Chinese construction projects). Zhou and Xu (2012) indicated that in emerging countries like China, the utilization of social relations is widespread (p. 678). An interviewee, who participated in one of the 18 semi-structured interviews, suggests that "*in projects filled with a high level of AT, the owner will not let the contractor work at a loss, and the contractor will endeavor to achieve overall project environmental objectives*". Our results and research context confirm Sydow and Braun (2018)'s view that stable inter-organizational relationships "from the past and future" frame the behavior at the project level (p. 9). Second, we identify the different trust ranges in increasing GWB (i.e., CT at a high-level range while AT at a low-level range). The resource and exchange perspectives can explain the promoting role of CT at a high-level range. Resource perspective suggests that high CT among projects tends to denote high confidence toward partners' resources and capabilities (Cerić et al. 2021; Gulati and Sytch 2007). This confidence can raise expectations for environmental objectives, placing tremendous pressure on contractors. The exchange perspective indicates that CT may promote opportunism beyond a certain threshold because of loosened monitoring and relational inertia in which the organization cannot perceive performance deterioration (Fang et al. 2008). Taken together, high CT equips contractors with the pressure to improve environmental performance and the opportunity to adopt opportunism. The promoting role of AT low-level range indicates that under low-AT circumstances, seeking more emotional attachment might be accompanied by opportunism. In this case, building trust does not aim to strengthen identity and a shared project culture but for the organization's short-term interest (Noordhoff et al. 2011). In sum, the limitations of CT and AT in mitigating GWB vary. We are required to pay attention to these limitations.

Thirdly, the results indicate that CC positively influences EC, whereas CO exerts an inverted U-shaped influence, not supporting H3a but supporting H3b. As for CC, we find that high CC does not exhibit an inhibition effect on proactive and informal environmental collaboration. Instead, environment-related contract terms specify environmental objectives and standards, organizations' responsibilities, the scope for using environmental funds (e.g., civilized construction fee), and principles to adapt to changing institutional environment and handle environmental contingencies (Yang 2017). Consequently, the project team establishes a set of "basic routines" regarding environmental issues (You et al. 2018). These routines lay the solid foundation to promote flexible problem-solving and environmental knowledge sharing. As for CO, we find that except for some projects with extremely high CO, most environmental collaborative activities can benefit from increasing CO. Poppo and Zenger (2002) indicated that high CO can cause conflicts and disagreements over environmental objectives, therefore discouraging the relation-oriented exchange between the contractor and other organizations. In sum, CC and CO positively affect EC except when the CO is at a high level.

Fourthly, the results suggest that CC exerts a U-shaped effect on contractor GWB and CO exerts a negative effect, not supporting H4a but H4b. First, CC does not demonstrate a consistent mitigation effect on GWB. A specific range (i.e., $x \in (3.813$, high contractual completeness) in Fig. 4) indicates incompetence of high CC. This differs from prior studies emphasizing the consistent mitigating power of CC in opportunism (Lu et al. 2016). This finding can be ascribed to the nature of GWB. Signaling theory deems GWB as the "environment-related signaling" that some contractor issues to gain environmental legitimacy (Truong and Pinkse 2019). However, our result suggests that CC is of limited use in judging the quality of this signal. Even if several projects have identified "fake certificate or photo" as a "critical environmental risk" enclosed in the project contract (Yang 2017 pp. 121–123), many kinds of GWB remain elusive. Tam et al. (2007) noted that organizations can declare their environmental performance via newsletters, posters, and annual reports, even with social media (Jia et al. 2021). Thus, contractor GWB belongs to passive opportunism in that specific organizations purposely withhold environmental efforts (Wathne and Heide

2000). In this regard, contractor GWB violates principles and norms implicit in contracts instead of violating specified formal terms. This passive opportunism renders it laborious and ineffective to curtail GWB, even with relatively straightforward and adaptive terms. Second, as for CO, its beneficial role aligns with prior literature's finding that solid enforceability is indispensable in curbing GWB. Via strict reward and punishment mechanisms with high enforceability, CO considerably raises the cost of issuing fictitious signals. Contractors face more challenges to gain legitimacy through adopting "symbolic" communication. Consequently, high CO can eliminate the regulatory voids to adopt GWB within projects. This elimination is an effective "self-regulation" mechanism echoing external environmental regulations (He et al. 2020; Perez-Batres et al. 2012). In sum, CC and CO positively influence EC and GWB at most ranges. However, the limitation of extremely high CC in mitigating GWB cannot be ignored.

The combined effect of inter-organizational trust and formal contracts (RQ2)

Regarding RQ2, the results show a substitute impact of CT and CC on EC, and a complementary impact of AT and CO on contractor GWB, partially supporting H5 and H6. First, the substitute impact of CT and CC can be explained by the opposing logic of trust and formal contracts. Ghoshal and Moran (1996) argued that the combined use of relational governance and formal contracts is "fundamentally problematic" owing to conflicting structures and processes. CT is a "quasi-rational calculation and confidence" of a perceived partner's capability (Zhong et al. 2017), while high CC signifies confusion and questioning about the resources and capability owned by the other organization (Lu et al. 2016). This opposing logic harms collaborative activities aimed at trust and resource exchange. Second, in contrast, the complementary impact of AT and CO aligns with Poppo and Zenger (2002), which can be attributed to our research context (i.e., Chinese construction projects). Emerging countries like China usually have relatively weak regulations and cannot guarantee the legal enforceability of contracts (Zhou and Xu 2012). Additionally, the utilization of social relations during business practices is prevalent in China (Xu et al. 2022). AT is thus conducive to creating a "micro-level" institutional framework to ensure contractual execution, especially in emerging countries (Zhou and Xu 2012). Therefore, the relationship exchange culture embedded in the contractual application will constitute a beneficial complement to contracts. Overall, our findings on the combined role of trust and contract vary. Whether complement or substitute depends upon the diverse categories of inter-organizational governance factors involved.

Theoretical implications

This study contributes to communities of environmental sustainability and construction engineering and management in four facets. First, our main objective is to address a sustainability-oriented problem existing in construction project delivery, i.e., how to improve the efficiency and effectiveness of environmental management concurrently. Construction management literature addressed environmental efficiency- and effectiveness-related questions by exploring positive environmental practices (Rosenbaum et al. 2014; Wang et al. 2017). Rather, echoing the call of Murtha et al. (2011), this paper sheds fresh insights into the negative aspects of the EC. We combined SET and TCE to investigate the governance approaches of EC and GWB within an integrated framework. The results gain novel knowledge about collaboration research from social- and contract- mechanisms. The results advance environmental sustainability across multiple organizations involving construction engineering and management. Second, this study conduces to a deepening understanding of GWB literature in project and emerging-country settings. Through inter-organizational governance lenses, we identify a practical path to mitigate contractor GWB. We recognize contractor GWB as a set of "passive opportunism" that implicitly violates environmental principles and norms. This recognition provides a solid foundation for further research revealing contractor GWB's characteristics. Third, we derived curvilinear hypotheses to explore the U-shaped or inverted U-shaped effect of trust and contract. This further contributes to SET and TCE perspectives. Combined with the specific curve shape (Fig 2-4), Our regression analysis develops a fine-grained cognition of the particular range where trust and contract exhibit the "dark side" (Locatelli et al. 2022). Therefore, our research helps develop a contingency view of trust and contract by revealing their specific limitations in governing sustainability-oriented problems. Finally, analyzing the combined effects of trust and contract, this research enriches the stream regarding "complementarity versus substitute debate" in project governance literature. Our findings suggest that complementarity and substitute are not an "either-or" situation. There could not be a universal combined relationship between social- and economic-mechanism factors (Zhou and Xu 2012). By further analyzing the institutional characteristics of emerging countries such as China, the results advance our understanding of the impact of institutional legal enforceability and the emphasis of social relations on the combined roles of different governance factors.

Managerial implications

Project managers and policymakers have long faced the problem of improving environmental management efficiency and effectiveness. Our findings have several implications for addressing the problem from perspectives of environmental collaboration and greenwashing behavior, especially in emerging countries.

Sensibly utilizing inter-organizational trust

Cerić et al. (2021) indicated that the optimal extent of inter-organizational trust required in projects remains an open question. Our results suggest that project managers should develop contingent strategies for building and controlling two categories of trust. This paper offers nuanced practical implications to enable project organizations to be aware of heterogeneous "trust traps". First, we find that maintaining a relatively high level of CT (3.927 Likert score in our research) can effectively alleviate contractor GWB. Owing to the quasi-rational nature of CT (Zhong et al. 2017), we suggest that project owners constantly evaluate each organization's capability of performing environmental tasks. For instance, the project owner should learn about the contractor's managerial, financial, and technical abilities and reputation based on their previous project. The project managers should fully consider these factors at the inception and bidding stage and manage to avoid the lowest-bid approach. Besides, project managers are required to prevent "excessive" CT (> 3.927 in our analysis). Project owners should periodically "renovate" the perception of contractors' capabilities to prevent opportunism tendencies. We thus suggest that project owners enable more involvement in the environmental management activities, such as training programs and meetings. Besides, project owners can develop a consistent monitoring system with supervisors to form a trust triad network to receive feedback and continually revise their evaluation of contractors' capabilities. This initiative can also effectively diminish collusion between contractors and supervisors. Second, our findings suggest that the trap of AT emerges at a relatively low level (< 3.145 in our research). Project managers should be cautious about the affectional exchange in low AT. However, when high AT exists within a project, reciprocal activities among project organizations can be enhanced to curb contractor GWB further, especially in construction projects of emerging countries. It is also suggested that project managers deploy proper rewarding mechanisms for satisfactory contractors' environmental performance.

Sensibly utilizing formal contracts

This research can guide policymakers and project managers to design and apply contracts in a manner that promotes EC and curb GWB. First, despite the positive effect of contractual completeness (CC) on collaboration, we identify a potential trap of CC to GWB at a high level (> 4.213 in our research). In this vein, policymakers and project managers should combine the model contracts of construction projects (e.g., Fédération Internationale Des Ingénieurs Conseils (FIDIC) contract) to contemplate the efficiency of environment-related terms. The rules of environmental management procedures for contractors are typically attached in the annex to the general contract (Yang et al. 2017 p. 78). Given that GWB is a kind of "passive opportunism", we recommend that model contracts include the principle of "no intentional release of environmental misinformation" in the general contract and elaborate on the specific manifestations of GWB in the annex. Emerging countries' policymakers should prioritize this issue because limited legal enforceability renders it hard to identify GWB. Also, project managers can require contractors to disclose sufficient environmental information on notice boards to make up for contractual terms. Furthermore, among specific projects with the priority of environmental protection (e.g., water conservancy and hydroelectric projects), project managers are required to avoid excessive CC, which exerts extreme pressure on contractors. Second, project managers should keep CO relatively high (4.199 in our research) rather than an extreme level. This measure can help projects embrace efficiencies from much EC and effectiveness from little GWB. Project managers should also strengthen the oral description of enforceability. The description may enable contractors to be fully aware of the severe consequences of GWB, especially in emerging countries where legal enforceability is not well established.

Limitations and future research

This study has three limitations that indicate fruitful directions for future research. First, we investigated the influence of inter-organizational trust and formal contracts among multiple organizations in projects. However, our data and research model cannot capture all potential governance factors of environmental collaboration and contractor greenwashing behavior. Especially, Wang et al. (2022a) and Aguilera et al. (2021) suggested that the characteristics of managers play a crucial role in influencing environmental communications. Future research can leverage other research perspectives to explore how characteristics of project practitioners (especially project managers) (e.g., academic background, project experience) affect environmental collaboration and greenwashing behavior. Second, the institutional features (i.e., weak legal enforceability and strong social relationships) presented in our research context (China) are commonly found in many emerging countries. This implies that our findings hold applicability to other emerging countries. Nevertheless, these features may restrict the generalizability of our findings. In future studies, it would be valuable to incorporate multi-country contexts to more comprehensively assess the impacts of trust and contracts. Third, this research explores inter-organizational governance toward contractor GWB within construction projects. Prior research on corporate GWB has provided deep insights into external institutions. Unlike corporations, construction projects face more uncertain external institutional contexts (He et al. 2020). We hence recommend that subsequent research place external institutions and inter-organizational governance mechanisms within an integrated framework. This placement can help explore a more comprehensive governance scheme.

Conclusion

Aimed at investigating the efficiency and effectiveness of environmental management, this study explores the effect of inter-organizational trust and formal contracts on environmental collaboration and contractor greenwashing behavior. We provide an integrated framework grounded on social exchange theory and transaction cost economics. Our empirical analysis based on the quantitative survey data from China exhibits diverse linear, curvilinear, and combined influences of trust and contract. Cognition-based and affect-based trust positively impact environment collaboration, while they exhibit diverse curvilinear patterns to mitigate greenwashing behavior. We identify high cognition-based and low affect-based trust as potential "trust traps" that cannot prevent opportunism. Our results also reveal the positive relationship between contractual completeness and environmental collaboration and the inverted U-shaped effect of contractual obligatoriness. However, the relationship between contractual completeness and greenwashing behavior is U-shaped, whereas contractual obligatoriness can consistently help curtail greenwashing behavior. Our findings further make nuanced analyses based on the vertex of curvilinear shapes. The interaction analysis indicates trust and contract's partial substitution effect of collaboration and partial complementarity effect of greenwashing behavior. This study enriches the stream of construction and engineering management from the discussion on the efficiency and effectiveness of environmental management, especially in some emerging countries with insufficient legal enforceability and strong social relations (Wang et al. 2022b). We also provide a new framework for greenwashing knowledge from an inter-organizational governance standpoint in construction projects.

Data availability statement

Data generated or analyzed during the study are available from the corresponding author by request.

Acknowledgments

This paper was supported by the National Natural Science Foundation of China (Project Numbers: 71901101 and 71971161), the Fundamental Research Funds for the Central Universities, China (Program Number: 2662021JC002), and the program of China Scholarship Council (CSC) (No. 202206260227).

Supplemental materials

Table S1-S3 can be found online in the ASCE Library (www.ascelibrary.org).

References

Abdi, M., and P. S. Aulakh. 2017. "Locus of Uncertainty and the Relationship Between Contractual and Relational Governance in Cross-Border Interfirm Relationships." *J. Manag.*, 43 (3): 771–803. SAGE Publications Inc. https://doi.org/10.1177/0149206314541152.

Adomako, S., and M. D. Tran. 2022. "Environmental collaboration, responsible innovation, and firm performance: The moderating role of stakeholder pressure." *Bus. Strategy Environ.*, 31 (4): 1695–1704. Hoboken: Wiley. https://doi.org/10.1002/bse.2977.

Aguilera, R. V., J. A. Aragón-Correa, V. Marano, and P. A. Tashman. 2021. "The Corporate Governance of Environmental Sustainability: A Review and Proposal for More Integrated Research." *J. Manag.*, 47 (6): 1468–1497. https://doi.org/10.1177/0149206321991212.

Aiken, L. S., S. G. West, and R. R. Reno. 1991. *Multiple Regression: Testing and Interpreting Interactions*. SAGE.

Anderson, J. C., and D. W. Gerbing. 1988. "Structural equation modeling in practice: A review and recommended two-step approach." *Psychol. Bull.*, 103 (3): 411–423. https://doi.org/10.1037/0033-2909.103.3.411.

Armstrong, J. S., and T. S. Overton. 1977. "Estimating Nonresponse Bias in Mail Surveys." *J. Mark. Res.*, 14 (3): 396–402. American Marketing Association. https://doi.org/10.2307/3150783.

Bakker, R. M. 2010. "Taking Stock of Temporary Organizational Forms: A Systematic Review and Research Agenda." *Int. J. Manag. Rev.*, 12 (4): 466–486. https://doi.org/10.1111/j.1468-2370.2010.00281.x.

Braun, T., A. I. Ferreira, and J. Sydow. 2013. "Citizenship behavior and effectiveness in temporary organizations." *Int. J. Proj. Manag.*, 31 (6): 862–876. https://doi.org/10.1016/j.ijproman.2012.09.003.

Cao, Z., and F. Lumineau. 2015. "Revisiting the interplay between contractual and relational governance: A qualitative and meta-analytic investigation." *J. Oper. Manag.*, 33–34 (1): 15–42. https://doi.org/10.1016/j.jom.2014.09.009.

Cerić, A., M. Vukomanović, I. Ivić, and S. Kolarić. 2021. "Trust in megaprojects: A comprehensive literature review of research trends." *Int. J. Proj. Manag.*, 39 (4): 325–338. https://doi.org/10.1016/j.ijproman.2020.10.007.

Chatterjee, S., and A. S. Hadi. 2015. *Regression Analysis by Example*. John Wiley & Sons.

Cheng, X., S. Fu, and D. Druckenmiller. 2016. "Trust Development in Globally Distributed Collaboration: A Case of

U.S. and Chinese Mixed Teams." *J. Manag. Inf. Syst.*, 33 (4): 978–1007. Routledge. https://doi.org/10.1080/07421222.2016.1267521.

Child, J., and D. Faulkner. 1998. *Strategies of cooperation: managing alliances, networks, and joint ventures*. Oxford University.

Cropanzano, R., and M. S. Mitchell. 2005. "Social Exchange Theory: An Interdisciplinary Review." *J. Manag.*, 31 (6): 874–900. SAGE Publications Inc. https://doi.org/10.1177/0149206305279602.

Dangelico, R. M., and P. Pontrandolfo. 2015. "Being 'Green and Competitive': The Impact of Environmental Actions and Collaborations on Firm Performance." *Bus. Strategy Environ.*, 24 (6): 413–430. https://doi.org/10.1002/bse.1828.

Delmas, M. A., and V. C. Burbano. 2011. "The Drivers of Greenwashing." *Calif. Manage. Rev.*, 54 (1): 64–87. https://doi.org/10.1525/cmr.2011.54.1.64.

Denicol, J., A. Davies, and S. Pryke. 2021. "The organisational architecture of megaprojects." *Int. J. Proj. Manag.*, Trust and Governance in Megaprojects, 39 (4): 339–350. https://doi.org/10.1016/j.ijproman.2021.02.002.

Dervin, B. 1998. "Sense-making theory and practice: an overview of user interests in knowledge seeking and use." *J. Knowl. Manag.*, 2 (2): 36–46. MCB UP Ltd. https://doi.org/10.1108/13673279810249369.

Dunn, J., N. E. Ruedy, and M. E. Schweitzer. 2012. "It hurts both ways: How social comparisons harm affective and cognitive trust." *Organ. Behav. Hum. Decis. Process.*, 117 (1): 2–14. https://doi.org/10.1016/j.obhdp.2011.08.001.

Fang, E. (Er), R. W. Palmatier, L. K. Scheer, and N. Li. 2008. "Trust at Different Organizational Levels." *J. Mark.*, 72 (2): 80–98. SAGE Publications Inc. https://doi.org/10.1509/jmkg.72.2.80.

Feitosa, J., R. Grossman, W. S. Kramer, and E. Salas. 2020. "Measuring team trust: A critical and meta-analytical review." *J. Organ. Behav.*, 41 (5): 479–501. https://doi.org/10.1002/job.2436.

Field, A. 2013. *Discovering Statistics Using IBM SPSS Statistics*. SAGE.

Fisher, R. J. 1993. "Social Desirability Bias and the Validity of Indirect Questioning." *J. Consum. Res.*, 20 (2): 303. https://doi.org/10.1086/209351.

Fornell, C., and D. F. Larcker. 1981. "Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics." *J. Mark. Res.*, 18 (3): 382–388. https://doi.org/10.1177/002224378101800313.

Galvin, P., S. Tywoniak, and J. Sutherland. 2021. "Collaboration and opportunism in megaproject alliance contracts: The interplay between governance, trust and culture." *Int. J. Proj. Manag.*, Trust and Governance in Megaprojects, 39 (4): 394–405. https://doi.org/10.1016/j.ijproman.2021.02.007.

Ghoshal, S., and P. Moran. 1996. "Bad for Practice: A Critique of the Transaction Cost Theory." *Acad. Manage. Rev.*, 21 (1): 13–47. Academy of Management. https://doi.org/10.5465/amr.1996.9602161563.

Greco, M., M. Grimaldi, G. Locatelli, and M. Serafini. 2021. "How does open innovation enhance productivity? An exploration in the construction ecosystem." *Technol. Forecast. Soc. Change*, 168: 120740. https://doi.org/10.1016/j.techfore.2021.120740.

Green, S. D., and N. Sergeeva. 2019. "Value creation in projects: Towards a narrative perspective." *Int. J. Proj. Manag.*, Delivering Value in Projects and Project-Based Business, 37 (5): 636–651. https://doi.org/10.1016/j.ijproman.2018.12.004.

Gulati, R. 1995. "Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances." *Acad. Manage. J.*, 38 (1): 85–112. Academy of Management. https://doi.org/10.5465/256729.

Gulati, R., and M. Sytch. 2007. "Dependence Asymmetry and Joint Dependence in Interorganizational Relationships: Effects of Embeddedness on a Manufacturer's Performance in Procurement Relationships." *Adm. Sci. Q.*, 52 (1): 32–69. SAGE Publications Inc. https://doi.org/10.2189/asqu.52.1.32.

Haans, R. F. J., C. Pieters, and Z.-L. He. 2016. "Thinking about U: Theorizing and testing U- and inverted U-shaped relationships in strategy research." *Strateg. Manag. J.*, 37 (7): 1177–1195. https://doi.org/10.1002/smj.2399.

Hair, J. 2009. "Multivariate Data Analysis." *Fac. Publ.*

Handley, S. M., J. de Jong, W. C. Benton, S. Szabo, and J. Webster. 2019. "Perceived Greenwashing: The Effects of Green Marketing on Environmental and Product Perceptions." *J. Bus. Ethics*, (0123456789). https://doi.org/10.1007/s10551-020-04461-0.

He, Q., Z. Wang, G. Wang, J. Xie, and Z. Chen. 2022. "The Dark Side of Environmental Sustainability in Projects: Unraveling Greenwashing Behaviors." *Proj. Manag. J.*, 53 (4): 349–366. https://doi.org/10.1177/87569728211042705.

He, Q., Z. Wang, G. Wang, J. Zuo, G. Wu, and B. Liu. 2020. "To be green or not to be: How environmental regulations shape contractor greenwashing behaviors in construction projects." *Sustain. Cities Soc.*, 63: 102462. https://doi.org/10.1016/j.scs.2020.102462.

He, Q., J. Xu, T. Wang, and A. P. C. Chan. 2021. "Identifying the driving factors of successful megaproject construction management: Findings from three Chinese cases." *Front. Eng. Manag.*, 8 (1): 5–16. https://doi.org/10.1007/s42524-019-0058-8.

Heide, J. B. 1994. "Interorganizational Governance in Marketing Channels." *J. Mark.*, 58 (1): 71. Chicago: Amer Marketing Assoc. https://doi.org/10.2307/1252252.

Heide, J. B., and G. John. 1992. "Do Norms Matter in Marketing Relationships?" *J. Mark.*, 56 (2): 32–44. SAGE Publications Inc. https://doi.org/10.1177/002224299205600203.

Heirati, N., A. O'Cass, K. Schoefer, and V. Siahtiri. 2016. "Do professional service firms benefit from customer and supplier collaborations in competitive, turbulent environments?" *Ind. Mark. Manag.*, 55: 50–58. New York: Elsevier Science Inc. https://doi.org/10.1016/j.indmarman.2016.02.011.

Homayouni, H., C. S. Dossick, and G. Neff. 2021. "Three Pathways to Highly Energy Efficient Buildings: Assessing Combinations of Teaming and Technology." *J. Manag. Eng.*, 37 (2): 04020110. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000883.

Hu, X., and C. Liu. 2018. "Measuring efficiency, effectiveness and overall performance in the Chinese construction industry." *Eng. Constr. Archit. Manag.*, 25 (6): 780–797. Bingley: Emerald Group Publishing Ltd. https://doi.org/10.1108/ECAM-06-2016-0131.

Hubei Daily. (2018). Bright sword! Zheng Wan high-speed rail fined. available at: https://hb.qq.com/a/20181010/013474.htm (In Chinese).

Hurley, A. E., T. A. Scandura, C. A. Schriesheim, M. T. Brannick, A. Seers, R. J. Vandenberg, and L. J. Williams. 1997. "Exploratory and confirmatory factor analysis: guidelines, issues, and alternatives." *J. Organ. Behav.*, 18 (6): 667–683. https://doi.org/10.1002/(SICI)1099-1379(199711)18:6<667::AID-JOB874>3.0.CO;2-T.

Ibrahim, M. I. M. 2016. "Estimating the sustainability returns of recycling construction waste from building projects." *Sustain. Cities Soc.*, 23: 78–93. https://doi.org/10.1016/j.scs.2016.03.005.

Jia, J., G. Ma, S. Jiang, M. Wu, and Z. Wu. 2021. "Influence of social media use at work on construction managers' work performance: the knowledge seeker's perspective." *Eng. Constr. Archit. Manag.*, 28 (10): 3216–3235. Emerald Publishing Limited. https://doi.org/10.1108/ECAM-09-2020-0705.

Jiang, X., M. Li, S. Gao, Y. Bao, and F. Jiang. 2013. "Managing knowledge leakage in strategic alliances: The effects of trust and formal contracts." *Ind. Mark. Manag.*, 42 (6): 983–991. https://doi.org/10.1016/j.indmarman.2013.03.013.

Johnsson, F., I. Karlsson, J. Rootzén, A. Ahlbäck, M. Gustavsson, S. K. Kim, and Y. Lee. 2020. "The framing of a sustainable development goals assessment in decarbonizing the construction industry – Avoiding 'Greenwashing.'" *Renew. Sustain. Energy Rev.*, 131: 110029. https://doi.org/10.1016/j.rser.2020.110029.

Kitsis, A. M., and I. J. Chen. 2021. "Does environmental proactivity make a difference? The critical roles of green operations and collaboration in GSCM." *Supply Chain Manag. Int. J.* Bingley: Emerald Group Publishing Ltd. https://doi.org/10.1108/SCM-09-2020-0499.

Kurpierz, J. R., and K. Smith. 2020. "The greenwashing triangle: adapting tools from fraud to improve CSR reporting." *J. Bus. Ind. Mark.*, 11 (6): 1075–1093. https://doi.org/10.1108/SAMPJ-10-2018-0272.

Kwak, D.-H. (Austin), X. Ma, S. Kim, G. Zaefarian, M. J. Robson, Z. Najafi-Tavani, and S. Spyropoulou. 2021. "When does social desirability become a problem? Detection and reduction of social desirability bias in information systems research." *Inf. Manage.*, 58 (7): 103500. https://doi.org/10.1016/j.im.2021.103500.

Li, Y., and Y. Ning. 2022. "Mitigating Opportunistic Behaviors in Consulting Projects: Evidence from the Outsourced Architectural and Engineering Design." *J. Constr. Eng. Manag.*, 148 (7): 04022044. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002305.

Li, Y., H. Sun, D. Li, J. Song, and R. Ding. 2022. "Effects of Digital Technology Adoption on Sustainability Performance in Construction Projects: The Mediating Role of Stakeholder Collaboration." *J. Manag. Eng.*, 38 (3): 04022016. https://doi.org/10.1061/(ASCE)ME.1943-5479.0001040.

Lind, J. T., and H. Mehlum. 2010. "With or Without U? The Appropriate Test for a U-Shaped Relationship*." *Oxf. Bull. Econ. Stat.*, 72 (1): 109–118. https://doi.org/10.1111/j.1468-0084.2009.00569.x.

Liu, Y., Y. Li, L. H. Shi, and T. Liu. 2017. "Knowledge transfer in buyer-supplier relationships: The role of transactional and relational governance mechanisms." *J. Bus. Res.*, 78: 285–293. https://doi.org/10.1016/j.jbusres.2016.12.024.

Locatelli, G., E. Konstantinou, J. Geraldi, and T. Sainati. 2022. "The Dark Side of Projects: Dimensionality, Research Methods, and Agenda." *Proj. Manag. J.*, 53 (4): 367–381. SAGE Publications Inc. https://doi.org/10.1177/87569728221103911.

Lu, W., L. Zhang, and L. Zhang. 2016. "Effect of Contract Completeness on Contractors' Opportunistic Behavior and the Moderating Role of Interdependence." *J. Constr. Eng. Manag.*, 142 (6): 04016004. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001110.

Lumineau, F. 2017. "How Contracts Influence Trust and Distrust." *J. Manag.*, 43 (5): 1553–1577. SAGE Publications Inc. https://doi.org/10.1177/0149206314556656.

Luo, Y. 2002. "Partnering with Foreign Firms: How Do Chinese Managers View the Governance and Importance of Contracts?" *Asia Pac. J. Manag.*, 19 (1): 127–151. https://doi.org/10.1023/A:1014895724927.

Lvsenanyang. (2019). Zhengwan High-speed Railway Nanyang Wolong Station project site dust pollution is shocking. available at: https://baijiahao.baidu.com/s?id=1629983907945524768&wfr=spider&for=pc (In Chinese)

Lyon, T. P., and A. W. Montgomery. 2015. "The Means and End of Greenwash." *Organ. Environ.*, 28 (2): 223–249. https://doi.org/10.1177/1086026615575332.

MacCormack, A., and A. Mishra. 2015. "Managing the Performance Trade-Offs from Partner Integration: Implications of Contract Choice in R&D Projects." *Prod. Oper. Manag.*, 24 (10): 1552–1569. Hoboken: Wiley-Blackwell. https://doi.org/10.1111/poms.12374.

McAllister, D. J. 1995. "Affect- and Cognition-Based Trust as Foundations for Interpersonal Cooperation in Organizations." *Acad. Manage. J.*, 38 (1): 24–59. https://doi.org/10.5465/256727.

Mesquita, L. F., and T. H. Brush. 2008. "Untangling Safeguard and Production Coordination Effects in Long-Term Buyer-Supplier Relationships." *Acad. Manage. J.*, 51 (4): 785–807. Academy of Management. https://doi.org/10.5465/amr.2008.33665612.

Moksony, F. 1999. "Small is beautiful. The use and interpretation of R2 in social research. Review of Sociology." *Spec. Issue*, 130–138.

Murtha, B. R., G. Challagalla, and A. K. Kohli. 2011. "The Threat from Within: Account Managers' Concern About Opportunism by Their Own Team Members." *Manag. Sci.*, 57 (9): 1580–1593. INFORMS. https://doi.org/10.1287/mnsc.1100.1298.

Musawir, A. ul, S. B. Abd-Karim, M. S. Mohd-Danuri, R. Morgan, D. Doran, and S. J. Morgan. 2020. "Project governance and its role in enabling organizational strategy implementation: A systematic literature review." *Int. J. Proj. Manag.*, 38 (1): 1–16. https://doi.org/10.1016/j.ijproman.2019.09.007.

Nee, V., H. J. Holm, and S. Opper. 2018. "Learning to Trust: From Relational Exchange to Generalized Trust in China." *Organ. Sci.*, 29 (5): 969–986. https://doi.org/10.1287/orsc.2018.1213.

Ning, Y. 2018. "Impact of quality performance ambiguity on contractor's opportunistic behaviors in person-to-organization projects: The mediating roles of contract design and application." *Int. J. Proj. Manag.*, 36 (4): 640–649. https://doi.org/10.1016/j.ijproman.2018.01.008.

Noordhoff, C. S., K. Kyriakopoulos, C. Moorman, P. Pauwels, and B. G. C. Dellaert. 2011. "The Bright Side and Dark Side of Embedded Ties in Business-to-Business Innovation." *J. Mark.*, 75 (5): 34–52. Thousand Oaks: Sage Publications Inc. https://doi.org/10.1509/jmkg.75.5.34.

Ozer, M. 2011. "A moderated mediation model of the relationship between organizational citizenship behaviors and job performance." *J. Appl. Psychol.*, 96 (6): 1328–1336. https://doi.org/10.1037/a0023644.

Paulraj, A., V. Jayaraman, and C. Blome. 2014. "Complementarity effect of governance mechanisms on environmental collaboration: does it exist?" *Int. J. Prod. Res.*, 52 (23): 6989–7006. Taylor & Francis. https://doi.org/10.1080/00207543.2014.920546.

Perez-Batres, L. A., J. P. Doh, V. V. Miller, and M. J. Pisani. 2012. "Stakeholder Pressures as Determinants of CSR Strategic Choice: Why do Firms Choose Symbolic Versus Substantive Self-Regulatory Codes of Conduct?" *J. Bus. Ethics*, 110 (2): 157–172. https://doi.org/10.1007/s10551-012-1419-y.

Podsakoff, P. M., S. B. MacKenzie, and N. P. Podsakoff. 2012. "Sources of Method Bias in Social Science Research and Recommendations on How to Control It." *Annu. Rev. Psychol.*, 63 (1): 539–569. https://doi.org/10.1146/annurev-psych-120710-100452.

Poppo, L., and T. Zenger. 2002. "Do formal contracts and relational governance function as substitutes or complements?" *Strateg. Manag. J.*, 23 (8): 707–725. https://doi.org/10.1002/smj.249.

Poppo, L., K. Z. Zhou, and J. J. Li. 2016. "When can you trust 'trust'? Calculative trust, relational trust, and supplier performance." *Strateg. Manag. J.*, 37 (4): 724–741. https://doi.org/10.1002/smj.2374.

Preacher, K. J., and A. F. Hayes. 2008. "Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models." *Behav. Res. Methods*, 40 (3): 879–891. https://doi.org/10.3758/BRM.40.3.879.

Ren, S., W. Lu, L. Zhang, and W. Guo. 2022. "When Does Familiarity Manifest its Dark Side in the Construction Industry: Moderating Roles of Task Uncertainty and Dependence Asymmetry." *IEEE Trans. Eng. Manag.*, 1–15. https://doi.org/10.1109/TEM.2022.3181061.

Reuer, J. J., and A. Ariño. 2007. "Strategic alliance contracts: dimensions and determinants of contractual complexity." *Strateg. Manag. J.*, 28 (3): 313–330. https://doi.org/10.1002/smj.581.

Rosenbaum, S., M. Toledo, and V. González. 2014. "Improving Environmental and Production Performance in Construction Projects Using Value-Stream Mapping: Case Study." *J. Constr. Eng. Manag.*, 140 (2): 04013045. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000793.

Sarhadi, M., S. Yousefi, and A. Zamani. 2018. "Participative project management as a comprehensive response to postmodernism criticisms." *Int. J. Manag. Proj. Bus.*, 11 (4): 935–959. https://doi.org/10.1108/IJMPB-10-2017-0119.

Sarstedt, M., and E. Mooi. 2014. *A Concise Guide to Market Research: The Process, Data, and Methods Using IBM SPSS Statistics*. Springer Texts in Business and Economics. Berlin, Heidelberg: Springer Berlin Heidelberg.

Shinkle, G. A., M. M. Yang, F. Yang, J. J. Elshaw, and D. J. Schleicher. 2021. "Enacting formal controls in information system development: Process guidance and goal importance." *Inf. Manage.*, 58 (2): 103430. Amsterdam: Elsevier. https://doi.org/10.1016/j.im.2021.103430.

Silvius, G., and R. Schipper. 2020. "Exploring variety in factors that stimulate project managers to address sustainability issues." *J. Bus. Res.*, 38 (6): 353–367. https://doi.org/10.1016/j.ijproman.2020.08.003.

Stevens, M., J. P. MacDuffie, and S. Helper. 2015. "Reorienting and Recalibrating Inter-organizational Relationships: Strategies for Achieving Optimal Trust." *Organ. Stud.*, 36 (9): 1237–1264. https://doi.org/10.1177/0170840615585337.

Sydow, J., and T. Braun. 2018. "Projects as temporary organizations: An agenda for further theorizing the interorganizational dimension." *Int. J. Proj. Manag.*, Festschrift for Professor J. Rodney Turner, 36 (1): 4–11.

https://doi.org/10.1016/j.ijproman.2017.04.012.
Tam, V. W. Y., L. Y. Shen, R. M. Y. Yau, and C. M. Tam. 2007. "On using a communication-mapping model for environmental management (CMEM) to improve environmental performance in project development processes." *Build. Environ.*, 42 (8): 3093–3107. https://doi.org/10.1016/j.buildenv.2006.10.035.
Tangpong, C., K.-T. Hung, and Y. K. Ro. 2010. "The interaction effect of relational norms and agent cooperativeness on opportunism in buyer-supplier relationships." *J. Oper. Manag.*, 28 (5): 398–414. https://doi.org/10.1016/j.jom.2009.12.001.
Tashman, P., V. Marano, and T. Kostova. 2019. "Walking the walk or talking the talk? Corporate social responsibility decoupling in emerging market multinationals." *J. Int. Bus. Stud.*, 50 (2): 153–171. https://doi.org/10.1057/s41267-018-0171-7.
Testa, F., O. Boiral, and F. Iraldo. 2018. "Internalization of Environmental Practices and Institutional Complexity: Can Stakeholders Pressures Encourage Greenwashing?" *J. Bus. Ethics*, 147 (2): 287–307. https://doi.org/10.1007/s10551-015-2960-2.
Tobin, J. 1958. "Estimation of Relationships for Limited Dependent Variables." *Econometrica*, 26 (1): 24. [Wiley, Econometric Society]. https://doi.org/10.2307/1907382.
Tomlinson, E. C., A. K. Schnackenberg, D. Dawley, and S. R. Ash. 2020. "Revisiting the trustworthiness–trust relationship: Exploring the differential predictors of cognition- and affect-based trust." *J. Organ. Behav.*, 41 (6): 535–550. https://doi.org/10.1002/job.2448.
Truong, Y., and J. Pinkse. 2019. "Opportunistic behaviors in green signaling: When do firms engage in symbolic green product preannouncement?" *Int. J. Prod. Econ.*, 218: 287–296. https://doi.org/10.1016/j.ijpe.2019.06.015.
Villena, V. H., T. Y. Choi, and E. Revilla. 2019. "Revisiting Interorganizational Trust: Is More Always Better or Could More Be Worse?" *J. Manag.*, 45 (2): 752–785. https://doi.org/10.1177/0149206316680031.
Villena, V. H., E. Revilla, and T. Y. Choi. 2011. "The dark side of buyer-supplier relationships: A social capital perspective⋆." *J. Oper. Manag.*, 29 (6): 561–576. https://doi.org/10.1016/j.jom.2010.09.001.
Wang, D., H. Fu, and S. Fang. 2019. "The efficacy of trust for the governance of uncertainty and opportunism in megaprojects." *Eng. Constr. Archit. Manag.*, 27 (1): 150–167. https://doi.org/10.1108/ECAM-09-2018-0409.
Wang, G., Q. He, X. Meng, G. Locatelli, T. Yu, and X. Yan. 2017. "Exploring the impact of megaproject environmental responsibility on organizational citizenship behaviors for the environment: A social identity perspective." *Int. J. Proj. Manag.*, 35 (7): 1402–1414. https://doi.org/10.1016/j.ijproman.2017.04.008.
Wang, G., Q. He, B. Xia, X. Meng, and P. Wu. 2018. "Impact of Institutional Pressures on Organizational Citizenship Behaviors for the Environment: Evidence from Megaprojects." *J. Manag. Eng.*, 34 (5): 04018028. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000628.
Wang, G., P. Wu, X. Wu, H. Zhang, Q. Guo, and Y. Cai. 2020a. "Mapping global research on sustainability of megaproject management: A scientometric review." *J. Clean. Prod.*, 259: 120831. https://doi.org/10.1016/j.jclepro.2020.120831.
Wang, G., S. Zeng, B. Xia, G. Wu, and D. Xia. 2022a. "Influence of Financial Conditions on the Environmental Information Disclosure of Construction Firms." *J. Manag. Eng.*, 38 (1): 04021078. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000982.
Wang, L., M. Song, M. Zhang, and L. Wang. 2021. "How does contract completeness affect tacit knowledge acquisition?" *J. Knowl. Manag.*, 25 (5): 989–1005. Emerald Publishing Limited. https://doi.org/10.1108/JKM-02-2020-0130.
Wang, M., Q. Zhang, Y. Wang, and S. Sheng. 2016. "Governing local supplier opportunism in China: Moderating role of institutional forces." *J. Oper. Manag.*, 46 (1): 84–94. https://doi.org/10.1016/j.jom.2016.07.001.
Wang, Q., B. Huo, and X. Zhao. 2020b. "What Makes Logistics Integration More Effective? Governance from Contractual and Relational Perspectives." *J. Bus. Logist.*, 41 (3): 259–281. https://doi.org/10.1111/jbl.12236.
Wang, R., W. Lu, and Y. Wei. 2022b. "Understanding the Inverted U-Shaped Relationship Between Contractual Complexity and Negotiation Efficiency: An Institutional Perspective." *IEEE Trans. Eng. Manag.*, 1–12. https://doi.org/10.1109/TEM.2021.3091673.
Wathne, K. H., and J. B. Heide. 2000. "Opportunism in Interfirm Relationships: Forms, Outcomes, and Solutions." *J. Mark.*, 64 (4): 36–51. https://doi.org/10.1509/jmkg.64.4.36.18070.
Williamson, O. E. 1979. "Transaction-cost economics: the governance of contractual relations." *J. Law Econ.*, 22 (2): 233–261. The University of Chicago Law School.
Williamson, O. E. 1991. "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives." *Adm. Sci. Q.*, 36 (2): 269. [Sage Publications, Inc., Johnson Graduate School of Management, Cornell University]. https://doi.org/10.2307/2393356.
Wu, G., C. Liu, X. Zhao, and J. Zuo. 2017. "Investigating the relationship between communication-conflict interaction and project success among construction project teams." *Int. J. Proj. Manag.*, 35 (8): 1466–1482. https://doi.org/10.1016/j.ijproman.2017.08.006.
Wu, Y., K. Zhang, and J. Xie. 2020. "Bad Greenwashing, Good Greenwashing: Corporate Social Responsibility and Information Transparency." *Manag. Sci.*, 66 (7): 3095–3112. https://doi.org/10.1287/mnsc.2019.3340.
Xu, D., J. Dai, A. Paulraj, and A. Y.-L. Chong. 2022. "Leveraging digital and relational governance mechanisms in

developing trusting supply chain relationships: the interplay between blockchain and norm of solidarity." *Int. J. Oper. Prod. Manag.*, 42 (12): 1878–1904. Emerald Publishing Limited. https://doi.org/10.1108/IJOPM-02-2022-0122.

Xu, L., K. Mathiyazhagan, K. Govindan, A. Noorul Haq, N. V. Ramachandran, and A. Ashokkumar. 2013. "Multiple comparative studies of Green Supply Chain Management: Pressures analysis." *Resour. Conserv. Recycl.*, 78 (78): 26–35. https://doi.org/10.1016/j.resconrec.2013.05.005.

Xue, J., H. Yuan, and B. Shi. 2017. "Impact of Contextual Variables on Effectiveness of Partnership Governance Mechanisms in Megaprojects: Case of Guanxi." *J. Manag. Eng.*, 33 (1): 04016034. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000476.

Yan, L., and L. Zhang. 2020. "Interplay of Contractual Governance and Trust in Improving Construction Project Performance: Dynamic Perspective." *J. Manag. Eng.*, 36 (4): 04020029. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000791.

Yang, J. 2017. *Environmental Management in Mega Construction Projects*. Singapore: Springer Singapore.

Yang, W., Y. Gao, Y. Li, H. Shen, and S. Zheng. 2017. "Different roles of control mechanisms in buyer-supplier conflict: An empirical study from China." *Ind. Mark. Manag.*, 65: 144–156. https://doi.org/10.1016/j.indmarman.2017.04.002.

You, J., Y. Chen, W. Wang, and C. Shi. 2018. "Uncertainty, opportunistic behavior, and governance in construction projects: The efficacy of contracts." *Int. J. Proj. Manag.*, 36 (5): 795–807. https://doi.org/10.1016/j.ijproman.2018.03.002.

Yusof, N., A. A. Tabassi, E. M. Kamal, A. Susarla, M. Holzhacker, and R. Krishnan. 2020. "Do environmental, economic and reputational advantages strengthen green practices' impact on environmental performance?" *Corp. Soc. Responsib. Environ. Manag.*, 27 (5): 2081–2093. Hoboken: Wiley. https://doi.org/10.1002/csr.1948.

Zardkoohi, A., J. S. Harrison, and M. A. Josefy. 2017. "Conflict and Confluence: The Multidimensionality of Opportunism in Principal–Agent Relationships." *J. Bus. Ethics*, 146 (2): 405–417. https://doi.org/10.1007/s10551-015-2887-7.

Zhan, W., W. Pan, and G. Hao. 2022. "Productivity Measurement and Improvement for Public Construction Projects." *J. Constr. Eng. Manag.*, 148 (6): 04022035. Reston: Asce-Amer Soc Civil Engineers. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002282.

Zhao, D., M. Duva, S. Mollaoglu, K. Frank, A. Garcia, and J. Tait. 2021. "Integrative Collaboration in Fragmented Project Organizations: Network Perspective." *J. Constr. Eng. Manag.*, 147 (10): 04021115. American Society of Civil Engineers. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002149.

Zhong, W., C. Su, J. Peng, and Z. Yang. 2017. "Trust in Interorganizational Relationships." *J. Manag.*, 43 (4): 1050–1075. https://doi.org/10.1177/0149206314546373.

Zhou, K. Z., and D. Xu. 2012. "How foreign firms curtail local supplier opportunism in China: Detailed contracts, centralized control, and relational governance." *J. Int. Bus. Stud.*, 43 (7): 677–692. https://doi.org/10.1057/jibs.2012.7.

Zhou, K. Z., Q. Zhang, S. Sheng, E. Xie, and Y. Bao. 2014. "Are relational ties always good for knowledge acquisition? Buyer-supplier exchanges in China." *J. Oper. Manag.*, 32 (3): 88–98. https://doi.org/10.1016/j.jom.2014.01.001.