project management horizons

MDPI

Article

Beyond Sufficiency: A Dual PLS-SEM–NCA Approach to Leadership Style, Psychological Safety, Team Trust, and Performance in Chinese Construction Teams

Samia Batool [1], Xuedong Liang [1], Ahmad Hassan Khalid [2], Nadia Rehman [3,*] and Amir Mahmood [4,*]

[1] Business School, Sichuan University, Chengdu 610065, China; samiabatool@stu.scu.edu.cn (S.B.); liangxuedong@scu.edu.cn (X.L.)
[2] Gas Turbine Service Division, Dongfang Turbine Co., Ltd., Deyang 618000, China; ahmadhassan03@yahoo.com
[3] The Joint Education Institute of Zhejiang Normal University and Kansas University, Zhejiang Normal University, Jinhua 321004, China
[4] College of Education, Zhejiang Normal University, Jinhua 321004, China
* Correspondence: nadiarehman05@zjnu.edu.cn (N.R.); amirmahmood@zjnu.edu.cn (A.M.)

Abstract

Construction leadership research has emphasized transformational and servant leadership but has paid limited attention to transactional leadership. This study compares how servant and transactional leadership relate to project team performance and team conflict/rework, with psychological safety and team trust as parallel mediators. Drawing on Path–Goal Theory and Social Exchange Theory, we analyzed data from 579 construction professionals in China using Partial Least Squares Structural Equation Modeling (PLS-SEM) and Necessary Condition Analysis (NCA). Servant leadership showed stronger associations than transactional leadership with higher performance and lower conflict/rework, and larger indirect effects. Psychological safety and team trust carried significant indirect effects in all eight mediation paths; mediation was partial, except that transactional leadership was linked to conflict/rework only through the mediators. Explanatory power was modest (R^2 = 0.31 for performance; 0.25 for conflict/rework). In this sample, all four conditions showed medium but modest necessity effects for high performance, whereas for low conflict/rework only servant leadership and psychological safety did (trust marginally). Because the data are cross-sectional and come from a high-power-distance, guanxi-oriented context, the findings are associations whose generalizability requires testing elsewhere. Combining sufficiency and necessity analyses gives construction firms an evidence-based starting point for leadership development.

Keywords: servant leadership; transactional leadership; psychological safety; team trust; project team performance; team conflict/rework; PLS SEM; necessary condition analysis; China

Check for updates

Academic Editor: Pramen P. Shrestha

Received: 12 August 2026
Revised: 1 October 2026
Accepted: 19 October 2026
Published: 3 November 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Introduction

Building projects are widely acknowledged as among the most intricate types of transitory organizations. Project teams comprise engineers, contractors, supervisors, and skilled labor with no prior history of collaboration, and they must complete highly interdependent work on tight schedules and budgets, amid fluctuating client requirements and constant technical and safety risks. Although project planning methods and digital construction technologies have continually improved, suboptimal leadership remains a leading cause of construction delays, cost overruns, quality issues, team conflict, and rework (Han et al.,

2024; Olasunkanmi et al., 2024). The research question has moved from whether leadership matters to what kind of leadership builds high-performing, collaborative teams.

In the wider leadership literature, there has been a shift towards relationships that focus on development, empowerment and teamwork. Servant leadership (SL), with its focus on follower growth and well-being (Greenleaf, 1970; Van Dierendonck, 2011), has received particular attention in construction studies. Some recent studies link it to project success through team learning and agility (Han & Zhang, 2024), interpersonal trust in megaprojects (Nauman et al., 2024), and team psychological resilience (Siddiquei et al., 2025). In contrast, transactional leadership (TL) focuses on defining goals, tracking progress, and providing feedback and consequences based on results compared against established standards (Bass, 1985), which is useful in construction's contractual, safety, and milestone-oriented operating environment (Altaher et al., 2024).

However, despite this, the research on construction leadership over the last few years has consistently shown an interest in transformational leadership and SL in relation to project success, team reflexivity, and project team resilience (Han et al., 2025; Thuy & Anh, 2024), which was also supported by meta-analytic findings that transformational leadership is preferred over TL (Abbas & Ali, 2023). As a result, TL has been used primarily as a point of comparison for other leadership styles, leaving it largely understudied. At the same time, construction continues to rely heavily on formal contracts, prescribed workflows, and performance monitoring, all of which are clearly transactional. Transactional and relational approaches may both foster trust and psychological safety (PS) when applied fairly and consistently, but this area remains underexplored.

When addressing this, it is important to consider the other psychological dimensions that are affected by leadership, such as PS (which allows team members to speak up and make mistakes without fear) and team trust (TT) (which is a measure of confidence in the competence, integrity, and benevolence of others) (Edmondson, 1999; Mayer et al., 1995). To date, there has been limited research in the field that investigates both constructs simultaneously, or whether they mediate SL and TL in the same or different ways, which is an open question that has been raised in a recent study on the relationship between SL and TL in project teams in the context of the evolving nature of the project environment (Papadonikolaki & Morgan, 2026).

This gap is particularly important in China, the world's largest construction market, where interpersonal relationships and leadership effectiveness are influenced by high power distance, guanxi orientation, and concerns over mianzi, or "face" (Bian, 2018; Hwang, 1987; Wang et al., 2025; Yunpeng & Zaman, 2024). In high-power-distance cultures, workers might be less inclined to speak up and share concerns, and the risk of causing a leader or colleague to lose face can further discourage open disagreement or admission of error—a dynamic with direct implications for psychological safety. Guanxi relationships, meanwhile, may result in a different form of trust than organizational structures do. Recent evidence shows that these cultural aspects significantly affect PS, knowledge sharing, and safety behavior among Chinese construction workers (Newaz et al., 2021), suggesting that Western-derived leadership mechanisms cannot be assumed to transfer directly.

This study draws on Path–Goal Theory (R. J. House, 1971) and Social Exchange Theory (Blau, 1964) to explain these mechanisms. Path–Goal Theory can include both SL (removing barriers by empowering and supporting) and TL (removing uncertainty by structuring, monitoring, and contingent rewarding); Social Exchange Theory can apply to both SL (caring, developing) and TL (structuring, monitoring, contingent rewarding).

Although leadership in project management has been extensively studied, some key areas remain less understood. First, SL is rarely studied alongside TL in construction teams, making it difficult to conduct empirical research that compares SL against a shared baseline.

Second, previous studies tend to focus on either PS or trust within a team. However, they do not address both and do not clearly distinguish whether these two are complementary or competing mediators. Third, most construction leadership research focuses solely on performance but ignores rework and conflict, which are also significant sources of cost and schedule overruns; therefore, a leadership style that increases productivity but also increases conflict could not be viewed as a success.

Accordingly, this study compares how SL and TL relate to project team performance (PTP) and team conflict/rework (TCR), and tests the parallel mediation of PS and TT in a Chinese construction team. Because leadership effectiveness, trust formation, and willingness to voice concerns are culturally contingent (Bian, 2018; Hwang, 1987; Newaz et al., 2021), the findings reported here should be understood as specific to this Chinese construction context. We return to this point in the theoretical implications section, where we distinguish patterns we expect to replicate across institutional settings from those we expect to be culturally bounded. The study examines both styles within the same Path–Goal/Social Exchange framework, treating TL as a focal style rather than only as a comparison point, and models PS and TT as co-occurring mediators of both a positive outcome (performance) and a negative outcome (TCR). The results are intended to provide actionable insights into developing leadership capacity to enhance performance and decrease interpersonal conflict and rework.

2. Literature Review and Hypothesis Development

2.1. Transactional Leadership

TL is a leadership style that involves communication between the leader and the follower. It depends on active management by exception, contingent incentive, and well-defined roles, expectations, and standards (Bass, 1985). Transformational leadership inspires people toward higher-order goals and shared values, while TL is more direct and immediate. Performance is judged against a fixed benchmark, and any shortfall is addressed and/or remediated. This exchange logic is reasonably applicable to construction projects, given their management through contracts, milestones, and safety regulations. However, although transformational leadership has received greater attention in research, research on TL in project management has been far less extensive, and the results less consistent. Han et al. (2024) found that TL enhances role clarity and immediate task performance, emphasizing structure and contingent reward.

Abbas and Ali (2023), however, uncovered through meta-analysis that it is not as effective at predicting project success as transformational leadership. Neither study nor, to be honest, any other study in this area, tries to explain why TL is effective when it is, or ineffective when it is not. The influence on performance is invariably assumed to be direct. This study contends that an intervening construct, PS and TT, mediates the effect of TL on PTP and TCR. This framing draws on Social Exchange Theory, which suggests that consistent, contingent exchanges build over time into relational capital (Blau, 1964), and on Path–Goal Theory, which suggests that role clarity eliminates ambiguity that would otherwise hinder the accumulation of relational capital over time (R. J. House, 1971).

2.2. Servant Leadership

In SL, the leader and follower roles are reversed. The leader no longer leads followers toward an organization's goals but serves, develops, and empowers them (Greenleaf, 1970). More contemporary approaches focus on humility, stewardship, empowerment, and a sincere desire to see followers grow and flourish (Van Dierendonck, 2011). It has also been associated with project success in project-based and construction settings, acting as sequential mediators, namely, team learning orientation and team agility (Han & Zhang,

2024), thus highlighting its role in facilitating adaptive and collaborative behaviors essential for dynamic project environments. In addition to the indirect path to team innovative performance, SL has been directly linked to team PS and, indirectly, to healthier workplace relationships more broadly, through the same mediation. The issue is that few of these facts are gathered during construction. Empirical evidence on servant leadership's relationship mechanisms is much more abundant than for TL. However, it largely relies on basic samples from healthcare and education and on more general organizational samples. A key question remains: do the trust- and safety-building effects of SL in other sectors still apply to a context such as a construction project, with its schedule-driven, hierarchical, and physically dispersed environment? How does the strength of SL compare with that of TL within the same model?

2.3. Psychological Safety

PS is a shared team attitude that creates a safe space to take interpersonal risks, speak up, admit mistakes, and challenge decisions without fear of punishment or embarrassment (Edmondson, 1999). Although conceptualized as a shared team climate, this study measures it as each respondent's perception of that climate, and we interpret it at the individual level. It consistently appears in the literature as a factor predicting voice behavior, learning behavior, and decreased destructive conflict. In a general organizational sample, Joo et al. (2023) concluded that PS completely mediates the link among organizational trust, empowering leadership, and group conflict. This also provides a relatively direct endorsement of mediation, although it is outside the construction domain. In the construction sector, PS studies have focused solely on safety behaviors and not overall team functioning. PS has been studied as a moderator between mindful leadership and workers' safety citizenship behavior (Meng et al., 2026), and between supervisors' paternalistic leadership and safety behaviors, team safety climate, and power distance (Wang et al., 2025). These studies support that PS responds to leadership in building contexts. However, they do not examine PS's role in PTP and conflict more generally, as this study does; thus, they do not reveal PS's role as a mediator between SL and TL and PTP, as well as TCR.

2.4. Team Trust

TT is members' willingness to be vulnerable to another party's actions, based on positive expectations of that party's ability, benevolence, and integrity (Mayer et al., 1995). McAllister (1995) distinguishes two foundations of such trust: cognition-based trust, which rests on judgments of the other party's competence, reliability, and dependability, and affect-based trust, which rests on emotional bonds and genuine care and concern. Because construction project teams are organized around a project manager whose decisions shape everyone's working conditions, this study focuses on members' trust in the project manager as the team's focal leader and captures both foundations; it does not examine peer trust. In construction, trust has been found to indirectly influence project management performance via knowledge sharing (Li et al., 2024), and it has long been recognized as a key mediator of coordination challenges in cross-functional, temporary teams under uncertainty and time constraints. The construction industry also shows evidence that organizational trust is established in ways beyond building trust. In concept, trust and PS are similar, but they are not the same. Trust is an outward judgment about others' reliability and benevolence. PS is a self-perception of the consequences of one's own actions, and can be directed inward (Edmondson, 1999; Mayer et al., 1995). A team can have a competent leader, but no one in the team would feel comfortable speaking up in a hierarchical culture of safety; a peer-level culture of safety can coexist without complete reliance on leadership. This study distinguishes between the two components of the exchange-based, judgmental

aspect of leadership effects (trust) and the voice-enabling aspect of leadership (PS), as the construction leadership literature has not tested them together.

2.5. Project Team Performance

PTP, as used here, refers to a project team's perceived achievement of its schedule, cost, quality, and safety objectives, the task-oriented side of project success. Schedule, cost, and quality form the traditional "iron triangle" of project success (Atkinson, 1999); safety is added because health and safety is a standard key performance indicator for construction projects (Chan & Chan, 2004). Construction leadership research has linked project performance to several mediating team processes: team flexibility and team agility under transformational leadership (Han et al., 2024), team reflexivity and resilience (Han et al., 2025), and knowledge-sharing behavior under conditions of asymmetric trust (Li et al., 2024). Across nearly all of this work, PTP is treated as the main, and often the only, dependent variable. This study departs from that pattern by modeling TCR as a co-equal outcome alongside performance rather than as an afterthought.

2.6. Team Conflict/Rework

Two related coordination problems are common on construction projects: relational conflict and rework. Relational conflict includes interpersonal conflict, lack of trust, and failure to cooperate. It is closely linked to, but distinct from, rework, which is unplanned work done to correct work that did not meet specifications the first time. Rework is no small item. Recent industry data indicate that it can drive a significant share of total cost growth and schedule overruns, and most occurrences stem from communication issues, design-coordination problems, and disagreements among project participants rather than technical issues (Jabbar & Khoiry, 2025).

This study defines TCR as a breakdown in team coordination and interpersonal functioning that shows itself in two ways: interpersonal friction and disputes among team members, and rework caused by miscommunication, unclear instructions, or misunderstandings. Rework in construction has many other sources, including technical error, design change, material defects, and inconsistencies with specifications, and conflict does not necessarily produce rework. These other forms of rework lie outside the construct by definition. we combined these two relationally rooted manifestations because they share a common origin. Process conflict, disagreement about who does what and how work is coordinated (Jehn & Mannix, 2001), and communication breakdowns between project participants are also among the main recorded causes of rework (Jabbar & Khoiry, 2025; Love et al., 2016). Friction among members and communication-driven rework are therefore expected to rise and fall together as expressions of the same coordination failure, a condition for reflective measurement (Jarvis et al., 2003). The conflict literature in general distinguishes between task conflict, disagreement about the nature of the task, and relationship conflict, interpersonal conflict and hostility, and suggests that the two types can have very different and sometimes inverse effects on team performance and satisfaction (De Dreu & Weingart, 2003; Jehn & Mannix, 2001). That is one reason this study examines TCR separately from performance. A particular leadership style can increase performance but also increase relationship conflict, or decrease it without affecting performance, and a model that measures only performance would miss that.

2.7. Alternative Explanatory Frameworks

Two alternative accounts could explain how leadership reaches team outcomes. Social identity theory holds that leaders influence followers by embodying and shaping a shared group identity, so that leadership effects operate through members' identification with the team (Hogg, 2001; Van Knippenberg & Hogg, 2003); SL has been linked to outcomes

through such identification (Liden et al., 2014). Team effectiveness models in the input–mediator–output tradition locate leadership effects in team processes such as coordination, communication, and conflict management (Ilgen et al., 2005; Mathieu et al., 2008). We do not treat PS and TT as rivals to these accounts. Following Marks et al. (2001), they are emergent states, the relational conditions under which team processes unfold, and Edmondson' (1999) model places PS upstream of team learning behavior. Our model therefore isolates the relational states that leadership shapes, rather than the behavioral processes those states enable.

We ground the model in Social Exchange Theory rather than social identity theory for two reasons. First, we aim to compare servant and transactional leadership, and exchange theory places both styles on a common economic–social exchange continuum. In contrast, social identity theory speaks mainly to identity-rich styles and offers little account of contingent-reward leadership. Second, construction project teams are temporary and multi-organizational, and members often retain primary identification with their employing firm rather than the project team (Lundin & Söderholm, 1995). In contrast, exchange-based trust and safety can form rapidly among members without shared history (Kramer & Tyler, 1996). Social identity theory would also predict servant leadership's advantage (H13), so our design cannot adjudicate between the two accounts.

2.8. Hypothesis Development

2.8.1. Direct Associations of Leadership with Team Performance and Tcr

SL emphasis on empowerment, humility, and genuine concern for team members has repeatedly been tied to better task and innovative performance in non-construction settings, and, within construction project teams specifically, to team learning orientation and agility, both of which are established predictors of project success (Han & Zhang, 2024). On that basis:

H1. *SL is positively associated with PTP.*

Because it reduces hierarchical distance and encourages open dialogue, SL is also expected to lower the interpersonal friction and miscommunication that drive relational conflict and its material counterpart, rework:

H2. *SL is negatively associated with TCR.*

TL's effect on performance and conflict is harder to pin down. Its emphasis on role clarity and contingent reward may reduce ambiguity-driven errors and improve schedule adherence, consistent with Path–Goal Theory's account of leader-provided structure (R. J. House, 1971; Olasunkanmi et al., 2024). However, it also shows a weaker average effect than transformational leadership in meta-analytic work (Abbas & Ali, 2023), and a rigid, monitoring-heavy style may create friction in a hierarchical site culture. Given that, the direction of its effect cannot be assumed in advance. This study therefore proposes:

H3. *TL is associated with PTP (direction to be tested empirically). H4: TL is associated with TCR (direction to be tested empirically).*

2.8.2. Ps as a Mediator

PS has already been shown to mediate the relationship between leadership and group conflict in other organizational settings (Joo et al., 2023), and SL specifically has been shown to build PS directly in both project-based and general organizational contexts. Taken

together, this supports treating PS as a parallel mediating mechanism for both leadership styles, across both outcomes:

H5. *PS mediates the relationship between SL and PTP.*

H6. *PS mediates the relationship between SL and TCR.*

H7. *PS mediates the relationship between TL and PTP.*

H8. *PS mediates the relationship between TL and TCR.*

H7 and H8 address the least-studied part of the model. PS's mediating role has been tested for empowering leadership and organizational trust (Joo et al., 2023). For transformational leadership and SL in adjacent domains, no one has tested it as a mechanism linking TL specifically to construction PTP and TCR.

2.8.3. TT as a Mediator

TT has already been shown to shape construction project performance indirectly through knowledge sharing under conditions of asymmetric (Li et al., 2024), supporting its treatment as a mediator rather than a direct predictor of performance. Following the same logic used for psychological safety, and consistent with Social Exchange Theory's account of trust as something that accumulates through consistent, reciprocal exchange (Blau, 1964; Mayer et al., 1995), this study proposes TT as a second, parallel mediator for both leadership styles:

H9. *TT mediates the relationship between SL and PTP.*

H10. *TT mediates the relationship between SL and TCR.*

H11. *TT mediates the relationship between TL and PTP.*

H12. *TT mediates the relationship between TL and TCR.*

Testing H5 through H8 alongside H9 through H12 lets this study check whether PS and TT actually behave as distinct, complementary mediators, which is what their conceptual separation in the literature would predict (Edmondson, 1999; Mayer et al., 1995), or whether in practice one ends up absorbing the other's explanatory power within a construction project-team context.

2.8.4. Comparing Servant and Transactional Leadership

H5 to H12 state that both mediators transmit the effect of both styles, but they do not imply that the two styles build relational states equally. Social Exchange Theory separates economic exchange, which is specific, time-bound, and governed by explicit terms, from social exchange, which rests on open-ended obligations and on trust that the other party will reciprocate (Blau, 1964; Shore et al., 2006). SL is a social-exchange investment. Putting followers' interests ahead of one's own (Liden et al., 2008) is an unrequested contribution that followers tend to read as benevolence and to repay with affect-based trust and a willingness to take interpersonal risks (Mayer et al., 1995; McAllister, 1995). TL is closer to economic exchange. Contingent reward and explicit goals create predictability and signal competence and integrity, which supports cognition-based trust (Lewicki & Bunker, 1996; McAllister, 1995; Rousseau et al., 1998), but the stated terms limit obligation and give followers little reason to infer care. Its effect on PS is mixed. Clear expectations reduce the

risk of unknowingly falling short, whereas close attention to mistakes and deviations can raise the perceived cost of admitting error (Detert & Burris, 2007; Edmondson, 1999). We therefore expect TL to relate positively but more weakly than SL to both mediators.

The two styles should also differ less in how the mediators work than in how much each style produces of them. The links from PS and trust to the outcomes belong to the mediators, not to the leader who built them, so a given level of safety or trust should carry through to performance and conflict in the same way, regardless of which style produced it. Path–Goal Theory adds that part of each style's effect should bypass relational states altogether, because path clarification and barrier removal act directly on task ambiguity (R. J. House, 1971). We therefore expect partial mediation for performance under both styles, and we leave open whether TL relates to TCR beyond the mediators, given the mixed signal described above and the undirected H4. This reasoning leads to a comparative hypothesis, which follows from the study's aim of comparing the two styles:

H13. *The paths from SL to PS and TT, and the indirect effects of SL on PTP and TCR through PS and TT, are stronger than those of TL.*

Based on these hypotheses, we propose the conceptual model shown in Figure 1, in which PS and TT mediate the links between team outcomes (performance and TCR) and leadership styles (SL and TL).

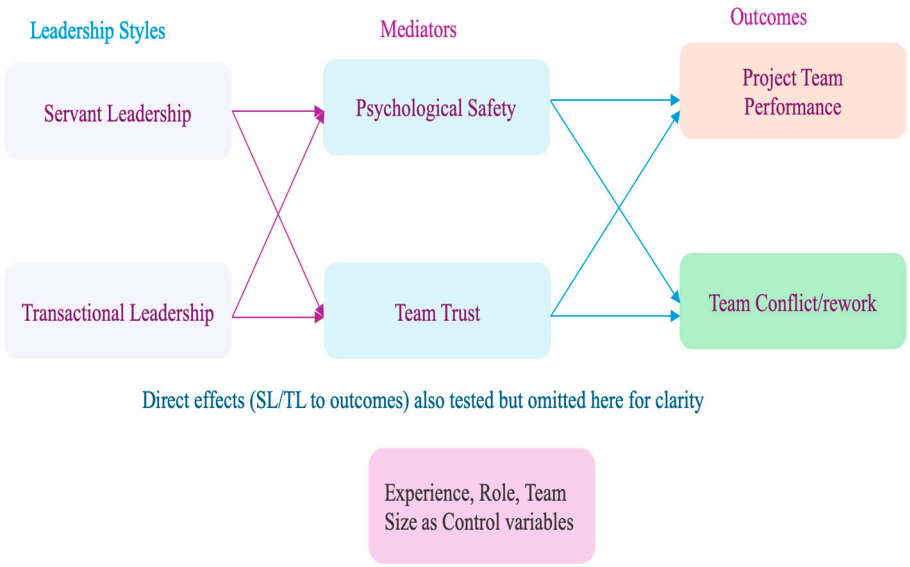


Figure 1. Conceptual Model.

3. Methodology

3.1. Research Design and Philosophy

This study uses a quantitative, cross-sectional, explanatory research design, consistent with most recent construction-leadership studies (Han et al., 2025; Joo et al., 2023; Li et al., 2024). The design is based on a positivist philosophical perspective in which a team's relational climate, and its relationship with leadership behavior and team outcomes, is treated as measurable through structured self-report measures and statistical inference. Because the data come from a single national context, we do not assume that the relationships estimated here generalize beyond Chinese construction project teams; the subsection on expected cross-cultural boundary conditions (under Theoretical Implications) sets out which patterns we expect to transfer to other settings and which may be culturally bounded.

3.2. Population and Sampling

579 The study sample comprised 579 genuine respondents actively involved in different building projects across China. The study used alum networks with expertise in engineering management and building cost from three prestigious colleges in Sichuan Province to collect data. This strategy improved the study's results' dependability and relevance in the construction industry by ensuring access to a knowledgeable and relevant participant pool.

The researchers first developed and validated the questionnaire in English using a standard translation and back-translation process, based on earlier relevant studies (Brislin, 1970). Two engineering management professors then carefully examined the questionnaire to identify and correct any discrepancies. Before sending the questionnaire to the intended participants, the researchers conducted a pilot test with a small sample of ten respondents. Based on their feedback, the researchers further refined the questionnaire.

The questionnaire consisted of three sections. The first part outlined the survey's aims, confidentiality of responses, and comprehensive instructions for completion, and also served as an introduction. The second part collected respondents' gender, age group, years of experience, professional role, and details of the project they were working on (such as project type, delivery method, phase, and team size). The final section included measurement scales and questions designed to evaluate the core concepts of the research.

Wenjuanxing, a well-known online survey platform in China, was used to send out the questionnaire to a specific sample of experts in the construction sector. The first sample comprised 20 eligible respondents from alum networks with expertise in engineering management and construction cost from three prestigious colleges in Sichuan Province, China. The following requirements had to be met for respondents to be included: (1) they had to be currently employed in the construction industry in a project-related role, such as site engineer, project manager/assistant project manager, project coordinator, contractor/subcontractor staff, quantity surveyor/cost engineer, or architect/design team member, and (2) they had to be actively involved in a construction project at the time of the survey, whether it was in the planning/design, execution/construction, or closeout/handover phases. Because there was no minimum requirement for professional experience, the sample included viewpoints from those with less than two years of experience to those with more than fifteen years.

These first participants were asked to distribute the questionnaire to additional qualified people in their professional networks to increase the sample size. To reach a larger audience while keeping the sample relevant to the research environment, we used this snowball sampling approach. We gathered data between December 2025 and May 2026.

We collected 591 questionnaires over the six-month data-collection period. Based on the following exclusion criteria, 579 of these were considered valid for analysis: (1) responses that were identical across all questions, indicating a lack of genuine engagement with the survey, and (2) illogical responses, such as people reporting an age of 25 with more than 12 years of experience. Table A1 shows the remaining individuals' demographic data.

3.3. Measurement Instruments

All constructs in this study were measured using previously validated multi-item scales adapted from the literature to fit the construction project context. We measured SL using the seven-item short form of the SL Questionnaire developed by Liden et al. (2008), and TL using 5 items adapted from Bass and Avolio (1995).

We measured PS with a five-item scale adapted from Edmondson's (1999) Team PS Scale. We measured TT using McAllister's (1995) eight-item scale, which comprises

cognition-based trust (TT1–TT4) and affect-based trust (TT5–TT8). The items were worded with the project manager as the referent, so TT captures members' trust in the team's focal leader rather than trust among peers. Because the hypotheses concern trust in the project manager as a whole, TT was modeled as a single reflective construct combining both components; all eight items loaded strongly on it (0.778–0.809). PTP was operationalized as a four-dimensional, higher-order construct comprising Schedule Performance (SCH; meeting milestones and addressing delays), Cost Performance (CST; staying within budget and using resources efficiently), Quality Performance (QLT; meeting specifications and client expectations), and Safety Performance (SAF; compliance with safety procedures, hazard control, and the rarity of incidents and near-misses), with each dimension measured using three items, drawing on the iron-triangle framework (Atkinson, 1999) and construction-specific KPI scales (Chan & Chan, 2004). Safety Performance thus covers both safety behaviors and safety outcomes (Neal & Griffin, 2006); it refers to occupational health and safety and should not be confused with psychological safety, which concerns the interpersonal risk of speaking up. All four dimensions are team members' perceptions rather than figures drawn from project records. TCR, the undesirable outcome, was measured using a six-item scale adapted from Jehn's (1995) intragroup conflict scale. As outlined in the literature review, conflict and rework on construction projects often share a relational origin in communication and coordination failures, and the review distinguishes between task and relationship conflict.

This study treats TCR as a single reflective construct but deliberately restricts its scope to this relationally rooted subset. The six items comprising TCR capture interpersonal friction, disputes, and conflicting priorities among team members, together with rework attributable specifically to miscommunication, unclear instructions, and misunderstandings (see Appendix A, Table A1), rather than rework driven by technical, design, or material causes, which falls outside this study's leadership-and-relational-process framework. The conflict items combine relationship conflict (personal conflicts and escalating disputes; TCR4 and TCR6) with task and process conflict (disagreement and conflicting priorities; TCR1 and TCR3). Because task conflict can be neutral or even useful when it stays focused on the work (De Dreu & Weingart, 2003), three of these items were worded to capture conflict that has already become dysfunctional, that is, conflict that slows work, harms progress, or escalates; TCR1 (frequent friction or disagreement) is broader and may also capture some constructive disagreement. Conceptualized this way, conflict and rework are treated as two observable manifestations of the same underlying breakdown in team coordination and interpersonal functioning, which is consistent with their empirical behavior in this sample: all six items loaded together at 0.796–0.848 with AVE = 0.670 and CR = 0.924, which is consistent with a single factor; a formal test of one- vs. two-factor structure is reported under Discriminant Validity. We return to this scope boundary in the Limitations section, where we note that technical and design-driven rework was outside this study's remit and represents an avenue for future research using an expanded, formative specification of rework.

As a robustness check, we added professional role, experience and team size as control variables on both outcome constructs (PTP and TCR), and tested role and team size as moderators of all twelve structural paths (see Robustness Checks in the Results; Supplementary Tables S1–S3).

We used a five-point Likert scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree," to score each item within each construct. Table A1 summarises the measurement structure; the Appendix A includes the full item wording.

3.4. Analytical Software and Overview

Analysis is conducted in SmartPLS 4 (Ringle et al., 2024) for the PLS-SEM measurement and structural model, PLSpredict and CVPAT for the mediation procedures, and the NCA of the latent variables (Dul et al., 2023). The overall analytical sequence follows six stages, each detailed in the subsections below: (1) measurement model assessment, (2) structural model assessment, (3) mediation analysis, (4) comparison of the two leadership styles, (5) Necessary Condition Analysis, and (6) PLSpredict out-of-sample predictive assessment.

The structural model contained twelve paths: from SL and TL to both mediators (PS and TT) and to both outcomes (PTP and TCR), and from PS and TT to both outcomes. Because the model includes direct paths from the leadership styles to the outcomes, the mediation results distinguish partial from indirect-only mediation (Zhao et al., 2010). Following PLS-SEM convention, we refer to path coefficients as direct, indirect, and total "effects"; because all constructs were measured at one time point, these are estimates of statistical association under the specified model, not evidence of causal effects. We used bootstrapping with 5000 subsamples, percentile confidence intervals, and a fixed seed. To compare the two styles, we computed the difference between the SL and TL estimates (paths, direct effects, specific and total indirect effects, and total effects) within each bootstrap subsample. We reported the 95% percentile confidence interval of that difference. Because both styles are estimated on the same respondents, the differences are paired, and an interval that excludes zero indicates a reliable difference. For NCA, CE-FDH was the main estimator, CR-FDH was a robustness check, and we tested significance with 5000 permutations. TCR scores were reversed (multiplied by -1) for the NCA so that necessity is assessed for low TCR. PLSpredict used 10 folds and 10 repetitions.

NCA identifies ceiling patterns in the data: combinations of a low condition and a high outcome that do not occur in the sample. A significant ceiling is consistent with the condition being necessary in degree. However, with cross-sectional data, it does not show that the condition is causally necessary, since the empty zone could also reflect reverse causality, unmeasured common causes, or sampling. The significant effect sizes observed here lie at the lower end of the medium range (d = 0.100 to 0.157). The marginal effect for TT on low TCR is small (d = 0.071), meaning the empty zone covers a small share of the observed scope, and estimates at the highest outcome levels rest on few cases. We therefore interpret the NCA results as statistical necessity within this sample and model, and refer to conditions as "showing a necessity effect" rather than as being "necessary" in a general sense.

4. Results

4.1. Measurement Validation

Before testing the hypothesis, we examined the constructs' validity and reliability, and used PLS-SEM to conduct a confirmatory factor analysis (Table 1). All loadings exceeded 0.70 (indicator reliability), all AVE values exceeded 0.50 (convergent validity), and all CR values exceeded 0.70 (internal consistency reliability) for the first-order reflective constructs (PS, SL, TCR, TL, and TT) (Hair et al., 2019).

4.2. Higher-Order Construct Assessment (Ptp)

PTP was modeled as a reflective-reflective higher-order construct (HOC) consisting of four lower-order constructs: SCH, CST, QLT, and SAF. We first estimated the scores of the four lower-order constructs and then used them as reflective indicators of the higher-order PTP construct (disjoint two-stage approach; Sarstedt et al., 2019). The items loaded above 0.84 on their dimensions; the four dimensions loaded 0.746–0.819 on PTP; and PTP

had high internal consistency reliability (α = 0.800, CR = 0.869) and convergent validity (AVE = 0.624 > 0.50), and PTP was a valid higher-order construct (Table 2).

Table 1. Measurement Model Results—First-Order Constructs.

Construct	Items	Loadings	VIF	α	rho_A	CR	AVE
Psychological Safety (PS)	PS1–PS5	0.821–0.832	2.045–2.131	0.885	0.887	0.916	0.685
Servant Leadership (SL)	SL1–SL7	0.783–0.820	2.010–2.237	0.908	0.910	0.927	0.645
Team Conflict/Rework (TCR)	TCR1–TCR6	0.796–0.848	2.005–2.412	0.901	0.903	0.924	0.670
Transactional Leadership (TL)	TL1–TL5	0.815–0.838	2.013–2.267	0.886	0.891	0.916	0.686
Team Trust (TT)	TT1–TT8	0.778–0.809	2.023–2.223	0.918	0.920	0.933	0.634

Table 2. Measurement Model—Higher-Order Construct (PTP).

Sub-Dimension (LOC)	Items	Loading	VIF
Schedule Performance	SCH1–SCH3	0.851–0.876	1.852–1.948
Cost Performance	CST1–CST3	0.845–0.874	1.785–2.080
Quality Performance	QLT1–QLT3	0.845–0.871	1.835–1.943
Safety Performance	SAF1–SAF3	0.857–0.870	1.850–1.901

Note: HOC-level reliability/validity: α = 0.800, rho_A = 0.808, CR = 0.869, AVE = 0.624. Dimension loadings on PTP: SCH = 0.811, CST = 0.782, QLT = 0.746, SAF = 0.819.

4.3. Discriminant Validity (Htmt)

The heterotrait–monotrait ratio of correlations (HTMT) was used to assess discriminant validity (Henseler et al., 2015). Since PTP was treated as a higher-order construct, HTMT was calculated at the higher-order level, meaning the dimensions of PTP were not assessed as separate constructs, but rather as a single latent construct against the other first-order constructs. Table 3 shows that all the HTMT values are below the conservative limit of 0.85 (Hair et al., 2021; Henseler et al., 2015); this indicated that the discriminant validity was supported for all constructs, including the HOC of PTP and its coexisting first-order constructs of PS, SL, TCR, TL, and TT. To examine further whether PS and TT are empirically distinct, we compared two-factor and one-factor confirmatory factor analysis (CFA) models of their 13 items (maximum likelihood, N = 579). The two-factor model fit well ($\chi^2(64) = 57.0$, CFI = 1.00, RMSEA = 0.000, SRMR = 0.019), whereas the one-factor model did not ($\chi^2(65) = 1465$, CFI = 0.653, RMSEA = 0.193, SRMR = 0.182; $\Delta\chi^2(1) = 1408$, $p < 0.001$), and the latent correlation between the two constructs was low (r = 0.156, 95% CI [0.07, 0.24]; Supplementary Table S4). The low correlation is consistent with the different referents of the two scales: the PS items refer to the project team, whereas the trust items refer to the project manager.

To test whether the conflict and rework items form one construct, we compared a one-factor model of the six TCR items with a two-factor model separating conflict (TCR1, TCR3, TCR4, TCR6) from rework (TCR2, TCR5) (maximum likelihood, N = 579). The one-factor model fit the data well ($\chi^2(9) = 15.7$, $p = 0.072$, CFI = 0.996, TLI = 0.994, RMSEA = 0.036, 90% CI [0.000, 0.065], SRMR = 0.013), with standardized loadings of 0.747–0.815. In the two-factor model ($\chi^2(8) = 10.5$, $p = 0.229$, CFI = 0.999, TLI = 0.997, RMSEA = 0.023, 90% CI [0.000, 0.057], SRMR = 0.011), the estimated correlation between the conflict and rework factors was 1.04 (SE = 0.020, 95% CI [1.00, 1.08]). A correlation above 1 makes the solution

inadmissible and shows that the two sets of items cannot be empirically separated. Because the rework factor had only two indicators, this comparison has limited power to separate the factors; the result shows that the conflict and rework items could not be distinguished in this sample, rather than proving that they reflect a single construct in general. The nominal improvement in fit ($\Delta\chi^2(1) = 5.2$, $p = 0.023$) reflects only this out-of-bounds correlation: the one-factor model is the two-factor model with the correlation fixed at 1, and the change in CFI (0.003) is well below the 0.01 threshold for a meaningful difference (Cheung & Rensvold, 2002). As a robustness check, we re-estimated the model with TCR measured by the four conflict items alone (loadings 0.831–0.867). All hypothesis decisions were unchanged. The largest change was in the non-significant direct effect of TL on TCR (β = 0.005 vs. 0.022), and no other coefficient changed by more than 0.006 (Supplementary Table S5).

Table 3. Discriminant Validity of Measures.

Construct	PS	PTP	SL	TCR	TL	TT
PS						
PTP	0.488					
SL	0.425	0.500				
TCR	0.441	0.315	0.449			
TL	0.235	0.283	0.168	0.110		
TT	0.156	0.384	0.351	0.293	0.173	

4.4. Structural Equation Model

The model's explanatory ability was assessed using the coefficient of determination (R^2) for the two outcome constructs, PTP ($R^2 = 0.311$) and TCR ($R^2 = 0.254$). The model accounted for 17.0% of the Variance in PS ($R^2 = 0.170$) and 11.7% of the Variance in TT ($R^2 = 0.117$) for the mediating constructs. Table 4 presents all results under the PLS-SEM benchmarks of Hair et al. (2019), where 0.25, 0.50, and 0.75 mark weak, moderate, and substantial explanatory power; these values are best described as weak

Table 4. R^2, R^2 Adjusted, and Q^2 predict.

Construct	R^2	R^2 Adjusted	Q^2 Predict
PS	0.170	0.167	0.164
PTP	0.311	0.306	0.209
TCR	0.254	0.248	0.162
TT	0.117	0.114	0.109

SRMR = 0.038.

Q^2predict used the PLSpredict process to evaluate the model's predictive significance. All Q^2predict values were positive (PS = 0.164, TT = 0.109, PTP = 0.209, TCR = 0.162), indicating that the model predicts better than a mean-based benchmark for every endogenous construct (Hair et al., 2021; Shmueli et al., 2019). However, the magnitudes are modest, and the indicator-level comparison with a linear-model benchmark provides a fuller picture later. We analyzed exogenous constructs' R^2 values for unique contribution using effect sizes (f^2). The strongest link is SL → PS (0.152), followed by SL → TT (0.105), PS → TCR (0.088), PS → PTP (0.086), and the direct paths SL → PTP and TCR (0.068 each). The TL paths are small or negligible (0.028 for TL → PS, just above the 0.02 threshold; 0.013 for TL → TT, 0.018 for TL → PTP, and 0.001 for TL → TCR, all below it), and all other effects are small (Cohen, 1988).

This indicates that SL has a more positive effect on the mediating mechanisms (PS, TT) than does TL. The effect of PS on PTP ($f^2 = 0.086$) and TCR ($f^2 = 0.088$) was small at the mediator-to-outcome stage, as was the effect of TT on PTP ($f^2 = 0.051$) and TCR ($f^2 = 0.027$).

We evaluated model fit using the standardised root mean square residual (SRMR). The SRMR was 0.038, below the suggested cut-off of 0.08 (Henseler et al., 2016), indicating an acceptable model fit (Table 5).

Table 5. Effect Size (f^2) Matrix.

Path	PTP	PS	SL	TCR	TL	TT
PTP						
PS	0.086			0.088		
SL	0.068	0.152		0.068		0.105
TCR						
TL	0.018	0.028		0.001		0.013
TT	0.051			0.027		

4.5. Common Method Bias (Cmb)

CMB is addressed both procedurally and statistically because all constructs are self-reported and measured once by the same respondent. When the 43 substantive items were analyzed, the first (single) factor explained 25.707% of the total variance, which is less than the 50% recommended by Podsakoff et al. (2003) (Table 6).

Table 6. Results of Harman's Single-Factor Test.

Component	Total Eigenvalue	% of Variance	Cumulative %
1	11.054	25.707%	25.707%

Note. Extraction Method: Principal Component Analysis. All items were entered into an unrotated exploratory factor analysis with extraction fixed to one factor.

We also performed a full collinearity test (Kock, 2015). We regressed each construct's score on the scores of all other constructs in the model and computed a VIF for each. VIFs of 3.3 or lower are taken as evidence that the model is not contaminated by common method bias (Kock, 2015). The full-collinearity VIFs ranged from 1.086 (TL) to 1.461 (SL), well below this threshold.

4.6. Hypothesis Testing—Direct Relationships

Table 7 shows the results of direct relationship hypothesis testing, obtained via bootstrapping with 5000 subsamples in a model that includes direct paths from both leadership styles to both outcomes alongside the two mediators. H1 proposed that SL is positively associated with PTP. This hypothesis was supported ($\beta = 0.246$, $t = 6.624$, $p < 0.001$), as the 95% confidence interval for β [0.172, 0.317] did not include zero. H2 proposed that SL is negatively associated with TCR. The results supported this hypothesis, revealing a significant negative association ($\beta = -0.255$, $t = 6.399$, $p < 0.001$, 95% CI [−0.329, −0.174]).

Table 7. Direct Effect.

Hyp.	Path	β	t-Value	*p*-Value	95% CI [LL, UL]	Decision
H1	SL → PTP	0.246	6.624	0.000	[0.172, 0.317]	Supported
H2	SL → TCR	−0.255	6.399	0.000	[−0.329, −0.174]	Supported
H3	TL → PTP	0.114	3.178	0.001	[0.044, 0.185]	Supported
H4	TL → TCR	0.022	0.584	0.559	[−0.050, 0.098]	Not supported

H3 proposed that TL is associated with PTP, in either direction. TL was positively associated with PTP ($\beta = 0.114$, $t = 3.178$, $p = 0.001$, 95% CI [0.044, 0.185]), supporting H3; however, the association was smaller than for SL ($\beta = 0.114$ vs. 0.246). H4 proposed that TL

is associated with TCR; we tested the direction empirically. The results did not support H4: the direct effect of TL on TCR was close to zero and not significant (β = 0.022, t = 0.584, p = 0.559, 95% CI [−0.050, 0.098]). The total effect of TL on TCR, which adds the two indirect effects reported below, was also not significant (β = −0.038, 95% CI [−0.110, 0.037]).

Overall, H1–H3 were supported, and H4 was not. SL was more strongly associated with PTP (β = 0.246 vs. 0.114) and TCR (β = −0.255 vs. 0.022) than TL, indicating that SL behaviors are more closely associated with project team outcomes in this context. The comparison below formally tests these differences.

4.7. Mediation Analysis

We conducted bootstrapping with 5000 subsamples, following Preacher and Hayes (2008) and Nitzl et al. (2016), to examine the mediating roles of PS and TT. If the 95% bootstrap confidence interval does not include zero, the mediation effect is considered substantial (Table 8). We classified mediation as complementary (partial) when the direct and indirect effects were both significant and had the same sign, and as indirect-only when the indirect effect was significant and the direct effect was not (Zhao et al., 2010).

Table 8. Specific Indirect Effect Testing Results.

Hyp.	I. Path	I. β	95% CI [LL, UL]	t	p	D.E β [95%CI]	T.E β [95%CI]	VAF	M.T
				SL → PTP					
H5	SL → PS → PTP	0.096	[0.066, 0.129]	5.988	<0.001	0.246 *** [0.172, 0.317]	0.403 *** [0.336, 0.467]	23.9%	C
H9	SL → TT → PTP	0.062	[0.037, 0.090]	4.611	<0.001			15.3%	C
				SL → TCR					
H6	SL → PS → TCR	−0.101	[−0.138, −0.069]	5.796	<0.001	−0.255 *** [−0.329, −0.174]	−0.402 *** [−0.468, −0.335]	25.2%	C
H10	SL → TT → TCR	−0.046	[−0.073, −0.023]	3.527	<0.001			11.4%	C
				TL → PTP					
H7	TL → PS → PTP	0.041	[0.019, 0.067]	3.460	<0.001	0.114 ** [0.044, 0.185]	0.178 *** [0.106, 0.251]	23.3%	C
H11	TL → TT → PTP	0.022	[0.005, 0.043]	2.294	0.022			12.3%	C
				TL → TCR					
H8	TL → PS → TCR	−0.043	[−0.069, −0.021]	3.511	<0.001	0.022 n.s. [−0.050, 0.098]	−0.038 n.s. [−0.110, 0.037]	-	I. Only
H12	TL → TT → TCR	−0.016	[−0.034, −0.003]	2.115	0.034			-	I. Only

Note: I. (indirect), D.E (direct effect), T.E (total effect), C (complementary); VAF (variance accounted for = indirect effect ÷ total effect); I. Only (indirect-only mediation); n.s. (not significant); ** $p < 0.01$, *** $p < 0.001$.

All eight mediation hypotheses (H5–H12) were supported (Table 8). Six paths showed complementary mediation: PS and TT each transmitted part of the effect of SL on both outcomes and of TL on PTP, while both leadership styles retained significant direct effects. Taken together, the two mediators accounted for 39.1% of SL's total effect on PTP, 36.7% of its total effect on TCR, and 35.6% of TL's total effect on PTP. The two TL → TCR paths (H8 and H12) showed indirect-only mediation. Although the combined indirect effect of TL on TCR through PS and TT was significant (β = −0.060, 95% CI [−0.090, −0.033]), the small, non-significant positive direct effect (β = 0.022) offset it, so the total effect of TL on TCR was not significant (β = −0.038, 95% CI [−0.110, 0.037]), and this result should be interpreted cautiously.

Three patterns stand out in Table 8. First, every indirect effect of SL was larger in magnitude than the corresponding indirect effect of TL; we test these differences formally in the next subsection. Second, PS carried larger point estimates of the indirect effect than TT in the three leadership–outcome relationships with significant total effects (VAF of 23.3–25.2% through PS vs. 11.4–15.3% through TT). A bootstrapped comparison of the

specific indirect effects (5000 resamples, percentile confidence intervals) showed that the indirect effect through PS was significantly larger than that through TT only for the SL–TCR relationship (difference = −0.055, 95% CI [−0.100, −0.010]); the other three differences were not significant (Supplementary Table S6). Third, the two TT paths from TL (H11 and H12) produced the smallest indirect effects, with confidence intervals close to zero, so we regard them as the least robust of the eight results.

4.8. Comparing Sl and Tl (H13)

H13 predicted that SL would show stronger paths to the mediators and stronger indirect effects than TL. Because we estimated both styles on the same respondents, we tested each difference within the 5000 bootstrap subsamples (paired differences, SL minus TL) and report the 95% percentile confidence interval for the difference (Table 9). For the TCR paths, a negative difference means SL is associated with lower TCR than TL. SL had a stronger path than TL to PS (Δ = 0.205, 95% CI [0.093, 0.318]) and to TT (Δ = 0.198, 95% CI [0.077, 0.318]). All four specific indirect effects were also larger for SL, through PS (PTP: Δ = 0.055, 95% CI [0.024, 0.089]; TCR: Δ = −0.058, 95% CI [−0.096, −0.025]) and through TT (PTP: Δ = 0.040, 95% CI [0.014, 0.070]; TCR: Δ = −0.030, 95% CI [−0.056, −0.009]), and so were the total indirect effects. H13 is therefore supported. The direct effects also differed. SL's direct association with PTP was larger than TL's (Δ = 0.131, 95% CI [0.028, 0.234]), although this interval comes close to zero, and only SL had a negative direct association with TCR (Δ = −0.277, 95% CI [−0.385, −0.171]). The difference in total effects was large for both outcomes (PTP: Δ = 0.226, 95% CI [0.115, 0.332]; TCR: Δ = −0.364, 95% CI [−0.471, −0.258]). The gap between the two styles was about the same for the two mediators in absolute terms (0.205 for PS and 0.198 for TT; the difference between these gaps was 0.007, 95% CI [−0.162, 0.169]), so there is no evidence that TL lags SL less on trust than on PS.

Table 9. Comparison of SL and TL (SL − TL).

Comparison	SL	TL	Δ (SL − TL)	95% CI of Δ
Path to PS (a-path)	0.360	0.154	0.205	[0.093, 0.318]
Path to TT (a-path)	0.307	0.109	0.198	[0.077, 0.318]
Direct effect on PTP	0.246	0.114	0.131	[0.028, 0.234]
Direct effect on TCR	−0.255	0.022	−0.277	[−0.385, −0.171]
Indirect via PS → PTP	0.096	0.041	0.055	[0.024, 0.089]
Indirect via PS → TCR	−0.101	−0.043	−0.058	[−0.096, −0.025]
Indirect via TT → PTP	0.062	0.022	0.040	[0.014, 0.070]
Indirect via TT → TCR	−0.046	−0.016	−0.030	[−0.056, −0.009]
Total indirect → PTP	0.158	0.063	0.095	[0.054, 0.138]
Total indirect → TCR	−0.147	−0.060	−0.088	[−0.131, −0.049]
Total effect → PTP	0.403	0.178	0.226	[0.115, 0.332]
Total effect → TCR	−0.402	−0.038	−0.364	[−0.471, −0.258]

Note. Δ = SL − TL, computed within each of 5000 paired bootstrap subsamples; percentile 95% confidence intervals. For TCR paths, negative differences indicate a stronger reduction in TCR for SL.

4.9. Necessary Condition Analysis (Nca)

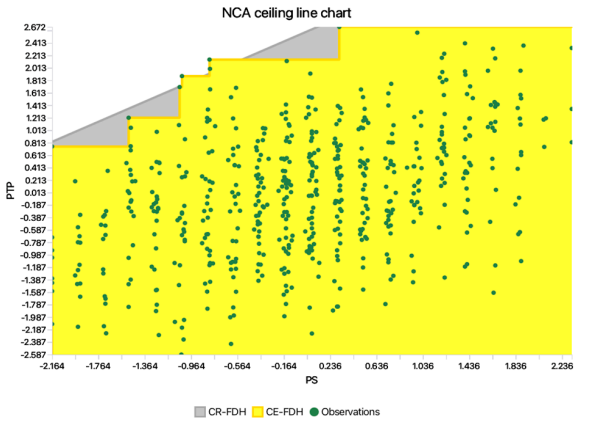
In addition to the sufficiency-based findings from PLS-SEM, we also conducted NCA to determine whether PS, SL, TL, and TT are necessary conditions for PTP and TCR (Dul, 2016). The ceiling envelopment with free disposal hull method (CE-FDH) was employed as the main estimation method because the survey data were discrete (Likert-type), and the method of ceiling regression using a free disposal hull (CR-FDH) was reported as a robustness check. For the necessity of low TCR, TCR scores were reversed (multiplied by −1) so that higher values indicate less TCR; with TCR in its original coding, the ceiling analysis would instead test whether high levels of a condition are needed for high TCR.

We assessed significance with 5000 permutations, and interpreted effect sizes using the benchmarks of Dul (2016).

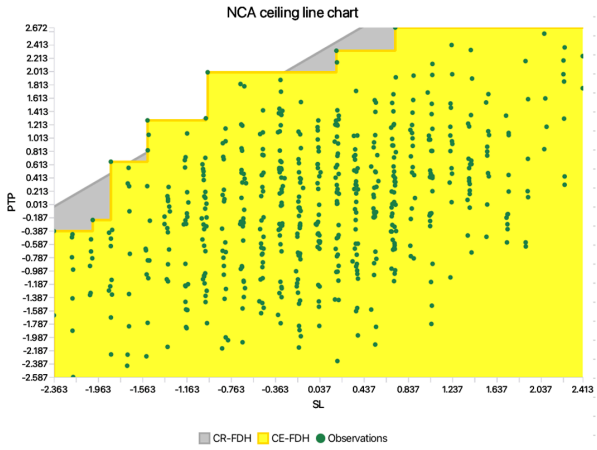
Table 10 and Figure 2 indicate that all four predictors showed positive and statistically significant necessity effects for PTP, using a permutation test with 5000 permutations (Dul, 2016). SL showed the largest necessity effect (d = 0.157, $p < 0.001$), followed by TT (d = 0.133, $p < 0.001$), PS (d = 0.115, $p < 0.001$), and TL (d = 0.104, $p = 0.003$). According to the effect size benchmarks provided by Dul (2016), d < 0.1 = small, 0.1–0.3 = medium, 0.3–0.5 = large, ≥0.5 = very large, these results suggest that the necessity effects for each of the four conditions are medium, although at the lower end of that band (0.104 to 0.157), with SL the largest. Most importantly, all four-permutation *p*-values are below the standard 0.05 cut-off, meaning that these necessity effects are unlikely to be due to chance. Within this cross-sectional sample, the data show a ceiling pattern consistent with each condition being necessary to some degree for PTP; given the modest effect sizes and the single-timepoint design, read this as sample-specific statistical necessity rather than a claim about universal or causal indispensability. Ceiling accuracy was 100% for all CE-FDH lines, as is the case by construction for this estimator, and CR-FDH estimates were similar in size and direction.

Table 10. NCA Results and Bottleneck Tables (CE-FDH) for Project Team Performance (PTP) and Low TCR (reversed TCR).

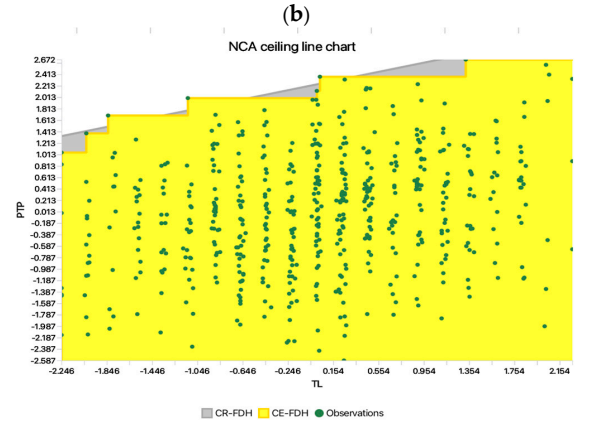
Necessary Conditions for Project Team Performance (PTP)					
Condition	**CE-FDH d**	**Permutation Threshold (d, 95th pct. of Null)**	**Permutation *p*-Value**	**Accuracy**	**Interpretation**
PS	0.115	0.077	0.000	100%	Medium, significant
SL	0.157	0.089	0.000	100%	Medium, significant
TL	0.104	0.080	0.003	100%	Medium, significant
TT	0.133	0.088	0.000	100%	Medium, significant
Necessary Conditions for Low TCR (reversed TCR)					
PS	0.100	0.058	0.000	100%	Medium (lower bound), significant
SL	0.115	0.072	0.000	100%	Medium, significant
TL	0.030	0.061	0.561	100%	Small, not significant
TT	0.071	0.071	0.047	100%	Small, borderline
Bottleneck Table (CE-FDH): Project Team Performance (PTP)					
PTP Level		**PS (%)**	**SL (%)**	**TL (%)**	**TT (%)**
0–40%		0	0	0	0
50%		0	3.5	0	0
60%		0	3.5	0	1.4
70%		6.6	7.1	1.4	4.0
80%		15.4	19.7	3.8	17.4
90%		22.5	55.1	53.4	47.8
100%		63.0	78.1	88.4	94.5
Bottleneck Table (CE-FDH): Low TCR (reversed TCR)					
Low TCR Level		**PS (%)**	**SL (%)**	**TL (%)**	**TT (%)**
0–40%		0	0	0	0
50%		0	0.3	0	0.9
60%		0	0.3	0	1.4
70%		7.8	1.6	0	1.4
80%		12.3	16.2	5.2	1.4
90%		37.1	25.7	5.2	19.3
100%		78.4	86.0	5.2	41.6



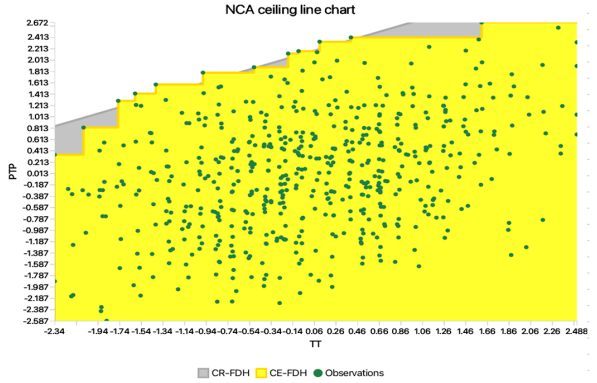
(**a**)



(**b**)



(**c**)



(**d**)

Figure 2. (**a**) NCA Ceiling Line Chart— PS and PTP. (**b**) NCA Ceiling Line Chart—SL and PTP. (**c**) NCA Ceiling Line Chart—TL and PTP. (**d**) NCA Ceiling Line Chart—TT and PTP.

For low TCR, the results differ by condition (Table 10; Figure 3). SL (d = 0.115, $p < 0.001$) and PS (d = 0.100, $p < 0.001$) showed significant necessity effects; against Dul's (2016) benchmarks, SL's effect is medium, and PS falls at the lower bound of the medium band (d = 0.100). TT was borderline (d = 0.071, $p = 0.047$), so we treat it as marginal, and TL showed no necessity effect (d = 0.030, $p = 0.561$). CE-FDH ceiling accuracy was 100% for all four conditions, and CR-FDH gave the same pattern (PS d = 0.086, $p < 0.001$; SL d = 0.111, $p = 0.002$; TL d = 0.026, $p = 0.535$; TT d = 0.077, $p = 0.047$) with accuracy between 98.8% and 99.5%. In other words, teams with low SL or low PS did not show the lowest TCR levels, whereas TL imposed no such floor.

Overall, the NCA results suggest that the pattern of necessity depends on the outcome. PTP showed medium necessity effects at the lower end of the band for all four predictors, which were statistically significant (all $p \leq 0.003$), with SL the strongest predictor (d = 0.157, $p < 0.001$). For low TCR, SL and PS showed significant necessity effects (d = 0.115 and 0.100, both $p < 0.001$), TT was marginal (d = 0.071, $p = 0.047$), and TL showed no necessity effect (d = 0.030, $p = 0.561$). Given this pattern, within the boundaries of this sample and model, SL, TL, PS, and TT each showed a statistically significant floor level below which high PTP was not observed; for low TCR, SL and PS showed such a floor, TT showed one only marginally, and TL showed none. These patterns describe statistical necessity within this cross-sectional dataset and should not be read as claims that any single factor is causally indispensable for practice. These results complement the PLS-SEM results, which showed that the average effect size (sufficiency) of both outcomes is significant, but this does not mean that the same conditions are also necessary, highlighting the importance of using both PLS-SEM and NCA in project management leadership research (Dul, 2016; Richter et al., 2020).

In addition to the line effect sizes, we created bottleneck tables to show the minimum level of each condition observed at given outcome levels (Dul, 2016). The tables translate the effect sizes into easier-to-interpret threshold values, although they describe this sample rather than general targets. Values in Table 10 are percentiles of each condition's distribution, that is, the share of teams in the sample whose level of the condition falls below the level required for the given outcome level.

Table 10 shows that, in this sample, no respondent reported PTP at 90% of its observed range unless SL was at or above percentile 55.1 of its distribution, TL at or above percentile 53.4, TT at or above percentile 47.8, and PS at or above percentile 22.5. Put concretely, roughly half of the teams in the sample had servant or TL below the level that every team at this performance level reached, whereas only about a fifth fell below the corresponding floor for psychological safety. For all four conditions, the observed floors rise steeply between the 70% and 100% outcome levels, indicating that the ceiling pattern is concentrated at higher PTP levels. At the maximum PTP level, the floors are higher still (TT percentile 94.5, TL 88.4, SL 78.1, and PS 63.0), but these values rest on the few respondents who reported maximum performance and are therefore less stable than those at the 90% level.

By contrast, Table 10 shows a different profile for low TCR. TL was needed only at a very low level (percentile 5.2) even at the highest levels of the outcome, whereas respondents reporting the maximum level of low TCR were all at or above percentile 78.4 on PS and 86.0 on SL, and those at the 90% level were at or above percentiles 37.1 and 25.7. TT lies in between (percentile 41.6 at the maximum level). This supports the ceiling line effect sizes and indicates that the lowest TCR levels were not observed in teams with low SL or low PS, whereas TL could be low without limiting that outcome.

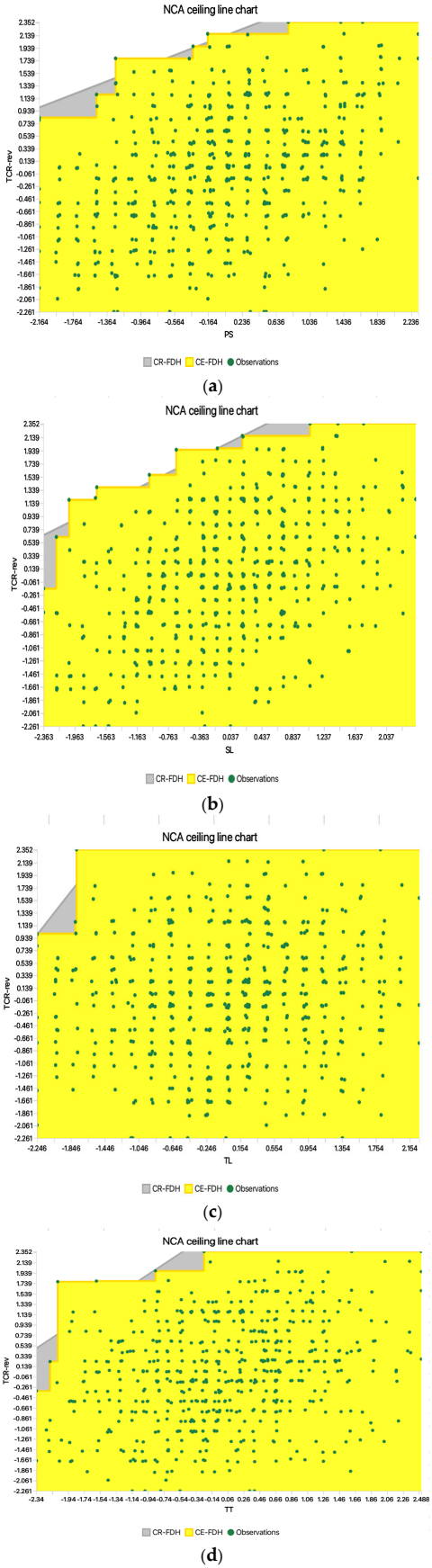


Figure 3. (**a**) NCA Ceiling Line Chart—PS and Low TCR (reversed TCR). (**b**) NCA Ceiling Line Chart—SL and Low TCR (reversed TCR). (**c**) NCA Ceiling Line Chart—TL and Low TCR (reversed TCR). (**d**) NCA Ceiling Line Chart—TT and Low TCR (reversed TCR).

4.10. Predictive Power (Plspredict)

To assess the model's out-of-sample predictive capability, we used the PLSpredict procedure for all four key endogenous constructs, following Shmueli et al. (2019). Table 11 shows that all Q^2predict values were greater than 0, with values ranging between 0.099 and 0.133 for the construct of PS, 0.043 to 0.084 for the construct of TT, 0.096 to 0.122 for the construct of TCR, and 0.082 to 0.158 for the construct of PTP, showing that in every construct, the model performs better than the mean-based benchmark. Construct-level Q^2predict values (Table 5) are higher than these indicator-level values because construct scores combine several indicators, which averages out item-specific prediction error.

Table 11. PLSpredict Results—Q^2predict and RMSE Comparison.

Indicator	Construct	Q^2 Predict	PLS-SEM RMSE	LM RMSE	PLS-SEM vs. LM
PS1	PS	0.103	1.052	1.064	PLS-SEM wins
PS2	PS	0.100	1.030	1.041	PLS-SEM wins
PS3	PS	0.124	0.981	0.995	PLS-SEM wins
PS4	PS	0.099	1.020	1.038	PLS-SEM wins
PS5	PS	0.133	1.008	1.020	PLS-SEM wins
TT1	TT	0.082	0.955	0.962	PLS-SEM wins
TT2	TT	0.050	0.992	0.999	PLS-SEM wins
TT3	TT	0.081	0.983	0.985	PLS-SEM wins
TT4	TT	0.071	0.973	0.980	PLS-SEM wins
TT5	TT	0.084	1.036	1.044	PLS-SEM wins
TT6	TT	0.071	1.032	1.037	PLS-SEM wins
TT7	TT	0.066	1.063	1.072	PLS-SEM wins
TT8	TT	0.043	1.015	1.027	PLS-SEM wins
TCR1	TCR	0.109	1.011	1.023	PLS-SEM wins
TCR2	TCR	0.111	0.973	0.989	PLS-SEM wins
TCR3	TCR	0.096	1.000	1.019	PLS-SEM wins
TCR4	TCR	0.116	1.011	1.018	PLS-SEM wins
TCR5	TCR	0.097	0.997	1.012	PLS-SEM wins
TCR6	TCR	0.122	1.019	1.034	PLS-SEM wins
CST	PTP	0.128	0.935	0.949	PLS-SEM wins
QLT	PTP	0.082	0.960	0.966	PLS-SEM wins
SCH	PTP	0.158	0.919	0.930	PLS-SEM wins
SAF	PTP	0.147	0.925	0.936	PLS-SEM wins

Following Shmueli et al. (2019), we compared the PLS-SEM prediction errors with those of a naïve linear model (LM) indicator by indicator. If all indicators of a construct have lower PLS-SEM error, predictive power is high; if a majority do, it is medium; if a minority or an equal number do, it is low; and if none do, the model lacks predictive power. PLS-SEM had lower RMSE than LM on all five PS indicators, all eight TT indicators, all six TCR indicators, and all four PTP dimension scores (23 of 23; because PTP is a higher-order construct, its rows in Table 11 are the scores of its four dimensions), which indicates high predictive power for every construct by this rule, although the margins were small (for example, PS1: 1.052 vs. 1.064; CST: 0.935 vs. 0.949) and the construct-level CVPAT results below qualify this for TT. All Q^2predict values were positive, so the model outperformed the mean-based benchmark on every construct and modestly improved on a simple linear model for the outcomes.

As a complementary check, we applied CVPAT (Liengaard et al., 2021; Sharma et al., 2023) at the construct level. PLS-SEM had significantly lower prediction loss than the indicator-average benchmark for all four constructs (all $p < 0.001$; overall average loss difference = −0.109), indicating predictive relevance beyond a naïve benchmark. Against

the linear model, PLS-SEM was significantly better for PS (−0.028, $p < 0.001$), TCR (−0.028, $p < 0.001$), and PTP (−0.019, $p = 0.002$), and overall (−0.022, $p < 0.001$). The difference was not significant for TT (−0.015, $p = 0.085$). The model therefore predicts better than both a naïve benchmark and a simple linear model for three of the four constructs and overall.

Overall, the indicator-level and CVPAT results show that the model outperforms naïve benchmarks for every construct and improves on a simple linear model for PS, TCR, and performance; TT is the exception in CVPAT. The absolute Q^2predict values are modest for every construct (0.209 for PTP, 0.162 for TCR, 0.164 for PS, and 0.109 for TT), so the results indicate modest rather than strong prediction. The modest outcome results are consistent with team performance and TCR being distal outcomes shaped by many factors outside the model, as discussed in the Discussion section. Because this study focuses on team outcomes, this is a substantive limitation, not a technical footnote: the model helps explain why some teams perform better, or experience less conflict and rework, than others, but it should not be used to forecast how a particular team or project will perform.

4.11. Robustness Checks

We checked the robustness of these findings to respondent and project characteristics by re-estimating the model with professional role (project manager or assistant project manager vs. other roles), experience, and team size as control variables on both outcomes. None of the controls was significantly associated with PTP or TCR (all $p \geq 0.332$; all $f^2 \leq 0.002$), and together they raised R^2 by only 0.002 for PTP and 0.001 for TCR (Supplementary Table S1). Adding the controls changed no direct or specific indirect effect by more than 0.005, and no conclusion changed: H1–H3 and H5–H12 remained supported, and the direct effect of TL on TCR (H4) remained non-significant ($\beta = 0.027$, $p = 0.488$; Supplementary Table S2). The two effects of TL through TT (H11 and H12) remained the weakest ($\beta = 0.022$, $p = 0.023$, and $\beta = -0.016$, $p = 0.035$), so we continue to regard them as the least secure results. In separate moderation models, neither role nor team size moderated any of the twelve structural paths: no interaction reached significance (smallest $p = 0.054$), and all Holm-adjusted p-values equalled 1.00 (Supplementary Table S3). These moderation tests have limited power, particularly for role, because only 101 respondents were project managers or assistant project managers, so small between-group differences cannot be ruled out.

5. Discussion

This study compared how servant leadership (SL) and transformational leadership (TL relate to PTP and TCR in Chinese construction project teams, and whether PS and TT carry these associations. Three findings stand out. SL was more strongly associated than TL with both outcomes and with both mediators. PS and TT carried part of these associations, with PS carrying a significantly larger share only for the link between SL and TCR. The pattern of necessity differed by outcome: all four resources showed necessity effects for performance, but only SL and PS did so for low TCR. The subsections below relate each finding to theory and to prior research.

5.1. Servant vs. Transactional Leadership

The stronger association of SL, relative to TL, with both PTP and TCR is consistent with social exchange theory's prediction that relational, need-fulfilling leader behaviors generate broader and more durable reciprocation than contingent, transaction-based exchanges. Where TL operates through a narrow exchange (effort for reward), SL signals sustained investment in followers' growth and welfare, which social exchange logic predicts should generalize across a wider range of follower behaviors and attitudes rather than being

confined to the specific task tied to a reward. This distinction offers one possible explanation for why servant leadership's advantage held for both outcomes in this study rather than one. The contrast is sharpest for TCR, where TL showed no significant direct or total association. The pattern is consistent with Nauman et al. (2024), and Han and Zhang (2024)'s meta-analytic evidence that contingent-reward leadership produces reliable but comparatively modest effects relative to relational leadership styles (Judge & Piccolo, 2004; Young et al., 2021). It also adds evidence from a context where the mechanism plausibly matters more than usual: in construction project teams, where conflict and rework often originate in strained working relationships rather than in ambiguous procedures, a leadership style built on relational investment is theoretically better positioned to address the root cause than one built on reward contingency.

Our finding that SL outperformed TL on average should not be read as a claim that structure and monitoring are the weaker tool in every situation. Three results already point the other way. First, TL was positively associated with performance beyond its effect on the mediators: 64% of its total association with performance was direct (a direct β of 0.114 against 0.063 through the two mediators), which is consistent with structure and monitoring working through role clarity as well as relational climate, although servant leadership's direct share is similar (61%), so this alone does not separate the two styles. Second, at high levels of performance the floor for TL was similar to that for SL (percentile 53.4 vs. 55.1 at the 90% level, Table 10), and higher at the maximum level (88.4 vs. 78.1), which is consistent with clear targets and close tracking mattering when the aim is high-quality delivery. However, the maximum-level estimates rest on few cases. Third, the necessity effect of TL was specific to performance: it showed no necessity effect for low TCR, whereas SL and PS showed significant effects in this sample (Table 10). Path–Goal Theory and the leadership-substitutes literature suggest where else this may hold. Where team members lack a shared history, as with unfamiliar subcontractors, the relational capital SL builds takes time to accumulate, and explicit deliverables, contingent rewards, and monitoring can provide the predictability trust has not yet delivered (Kramer & Tyler, 1996; Rousseau et al., 1998). In safety-critical phases such as work at height, excavation, or heavy lifts, the cost of a deviation is high and tolerance for discretion is low, so standardized procedures and active corrective monitoring are likely to be worth more than autonomy (Clarke, 2013). SL's emphasis on autonomy may also fit poorly with inexperienced crews who need direction (R. J. House, 1971; Kerr & Jermier, 1978). We did not measure subcontractor familiarity, hazard level, or worker experience, so these are propositions, not findings.

5.2. Psychological Safety and Team Trust as Mediators

The mediation results support PS and TT as the mechanisms through which this exchange process translates leader behavior into outcomes, consistent with their established roles as proximal and distal relational states in social exchange processes (Frazier et al., 2017). As set out in the hypothesis development, SL was expected to build both states through relational investment, and TL, through the predictability of economic exchange, to build them weaklier. Consistent with these expectations and with H13, the paths from SL to both mediators and SL's indirect effects were larger than TL's (Table 9). Our data do not show, however, that TL builds trust more efficiently than it builds PS: the gap between the two styles was about the same for PS (0.205) and TT (0.198), and trust was modeled as a single construct combining its cognition-based and affect-based components, so whether TL works mainly through cognition-based trust remains to be tested. The relative contribution of PS vs. TT is similar across styles: PS accounts for about 23–25% of the total effect and TT for about 11–15% for SL and TL alike, while the direct effect carries the remaining 61–64%. This suggests that SL and TL differ mainly in how much relational capital they generate and

not in how that capital operates: the paths from PS and TT to the outcomes are properties of the mediators, and the mediated share of the total effect is similar (36–39%) across the three relationships in which both effects are significant. PS showed larger indirect effects than TT in all four relationships. However, the difference was significant only for SL and TCR (Supplementary Table S6), so the two mediators appear broadly comparable in carrying these associations. TL's link to TCR, by contrast, ran only through the mediators. With a non-significant direct and total effect, TL does not appear to reduce TCR by itself, consistent with the mixed signal that monitoring-based leadership sends about PS.

Our mediation results partly agree with earlier studies. Joo et al. (2023) found that PS fully mediated the relationship between empowering leadership and group conflict; in our data, PS partially mediated servant leadership's association with TCR, and a significant direct path remained ($\beta = -0.255$). One explanation is that our outcome includes rework caused by unclear instructions, which a leader may reduce directly by clarifying work, not only through team climate. The larger indirect effect through PS than through TT is consistent with meta-analytic evidence that PS is a proximal antecedent of voice and learning behavior (Frazier et al., 2017). The smaller role of trust may reflect our measure: the trust items referred to the project manager, whereas the meta-analytic link between trust and team performance concerns trust among team members (De Jong et al., 2016).

5.3. Why Necessity Differs Across Outcomes

NCA asks a different question from PLS-SEM: whether high outcomes occur only when a resource is present at some minimum level, regardless of how strong other resources are (Dul, 2016). PTP behaved as a conjunctive outcome: all four resources showed significant necessity effects, meaning that, in this sample, high performance was observed only where each resource was above a minimum level, which suggests, but does not show, that a deficit in one may not be offset by surplus in another. Low TCR was conjunctive in part: SL and PS showed necessity effects, TT only a marginal one, and transactional TL none. The necessity structure therefore differs by outcome. In this sample, TL showed a floor for team performance but not for low TCR, whereas SL and PS showed a floor for both (and trust only a marginal one for low TCR). This is consistent with the economic-versus-social exchange distinction developed above and with the PLS-SEM result that TL had no reliable total association with TCR; it was not predicted in advance, and we treat it as a pattern to test in other samples. A sufficiency-only design, which this literature has relied on almost exclusively, would not have shown this pattern. In this sample, SL had both the strongest average association and the largest necessity effect for both outcomes; whether this reflects causal necessity requires longitudinal testing.

Three features of the data help explain why the necessity structure differs between the two outcomes. First, the outcomes differ in breadth. PTP combines schedule, cost, quality, and safety, and these dimensions draw on different resources: structure and progress tracking for schedule and cost, a willingness to speak up for quality problems and safety hazards, and trust for the coordination that all four require. A team may therefore be held back by whichever resource is weakest, producing the conjunctive pattern in Table 10. TCR, as measured here, is narrower. Its items describe friction, escalating disputes, and rework caused by miscommunication, all of which arise when problems are not raised or resolved early. Whether they are raised depends on whether members feel safe speaking and on a leader who attends to them, which is consistent with PS and SL but not TL, forming floors for low TCR. Monitoring and contingent reward reduce task ambiguity, but they do not remove interpersonal friction, and close attention to mistakes may even discourage people from admitting the errors that lead to rework (Edmondson, 1999). Second, the trust result may follow from what was measured. Our trust items concern the project

manager, whereas conflict- and miscommunication-driven rework arise largely among team members. PS, whose items refer to the team, is closer to that peer-level mechanism, which may explain why it showed a clear necessity effect for low TCR while trust showed only a marginal one. Third, the bottleneck tables show that low TCR is less demanding than high performance overall, but not uniformly. At the 90% outcome level, the observed floors were lower for low TCR than for performance on servant leadership, transactional leadership, and trust, but higher on PS (Table 10). Low TCR therefore does not appear to rest on a single adequate mechanism; in this sample, it showed floors on two relational resources, with PS the highest, and it was observed alongside low levels of the others. In this sense, the outcome is partly compensatory: low levels of transactional leadership, and to a lesser extent of trust, did not prevent low TCR in this sample, whereas no respondent with low PS or SL reported the lowest levels of TCR. These explanations were developed after the results were known, and necessity estimates at the highest outcome levels rest on few cases, so they should be tested in samples that measure peer-level trust and separate relationship conflict from task conflict.

5.4. Explanatory Reach

The model's explanatory and predictive power for the two team outcomes is modest, and readers should keep that in mind. Servant leadership, transactional leadership, psychological safety, and TT together explain 31.1% of the variance in PTP (R^2 = 0.311) and 25.4% in TCR (R^2 = 0.254), which leaves roughly 69% and 75% unaccounted for. Out-of-sample prediction was also modest (Q^2predict = 0.209 for performance and 0.162 for TCR), although the model outperformed both naïve and linear benchmarks (see Predictive Power in the Results). Significant paths should therefore not be mistaken for strong prediction. A standardized direct effect of 0.246 for SL on performance is meaningful, but it is one contribution among many to how a project team performs. Even the total association of SL with performance, which adds the direct effect (0.246) to the two indirect effects (0.096 through PS and 0.062 through TT), is 0.403; a one standard deviation higher SL score is therefore associated with a performance score less than half a standard deviation higher. The corresponding total for TL is 0.178 (0.114 direct, plus 0.041 and 0.022 indirect). The totals for TCR are −0.402 for SL and −0.038 for transactional leadership, the latter not significantly different from zero.

Much of the unexplained variance likely reflects conditions leaders do not control and that this study did not measure. Project complexity, including technical difficulty, design change, and the number of interfaces among trades, sets how hard the work is regardless of who leads it. Organizational support (resourcing, authority delegated to the project manager, safety and quality systems) shapes what a leader can actually do. Client behavior, such as funding stability, scope changes, payment delays, and approval turnaround, drives schedule and cost outcomes and generates rework that no team climate can prevent. Labor-market conditions, subcontractor availability, and material price swings add further variation, as do team-level features such as member competence, prior working history, and turnover. Measurement also contributes to the remainder. All constructs were self-reported by a single respondent, performance was perceived rather than drawn from schedule and cost records, and TCR was deliberately limited to relationally rooted rework, so technical and design-driven rework sits outside the model by construction. Because we did not measure any of these sources, we cannot say how the remaining variance is distributed among them. The necessity results point the same way. That each resource showed a floor for high performance in this sample (Table 10) is consistent with a deficit holding a team back, not with a surplus lifting it; a necessary condition is not a sufficient one. The medium-sized but modest necessity effects (d = 0.104 to 0.157) also indicate that

these resources constrain only part of the performance range. The results support that leadership and relational climate meaningfully contribute to team outcomes, but do not fully explain them.

6. Theoretical Implications

The implications below come from a single-country, cross-sectional, self-report study. We therefore present them as patterns observed in Chinese construction project teams that are consistent, or inconsistent, with existing theory, rather than as tests that extend or modify these theories. The final subsection, "Expected Cross-Cultural Boundary Conditions", considers which patterns may hold in other settings.

First, the stronger association of servant leadership than TL with PTP is consistent with Path–Goal Theory's proposition that supportive and participative leader behaviors are especially valuable when work is interdependent and uncertain (R. J. House, 1971; R. House & Mitchel, 1974), and with meta-analytic evidence that relational leadership shows stronger associations with performance than contingent-reward leadership (Judge & Piccolo, 2004; Young et al., 2021). The study adds evidence from a setting in which Path–Goal Theory has rarely been examined. However, because it did not measure task uncertainty and interdependence, it does not test the theory's contingency propositions directly.

Second, PS and TT accounted for part of the association between both leadership styles and both outcomes. This fits Social Exchange Theory's account of leader behavior as a resource that followers reciprocate through relational states such as trust and voice (Blau, 1964; Cropanzano & Mitchell, 2005). The weaker paths and indirect effects for TL (H13; Table 9) align with the theory's distinction between economic and social exchange (Shore et al., 2006). With cross-sectional data, these results show that the pattern of associations matches this account, not that the exchange process operates as theorized; reverse causality and identity-based explanations remain possible. Cultural extensions of Social Exchange Theory treat guanxi and mianzi as amplifiers of reciprocal obligation (Bian, 2018; Hwang, 1987; Wang et al., 2025), so the size of servant leadership's advantage may be larger in this context than elsewhere; without a comparison sample, this cannot be tested here.

Third, the NCA results suggest that it is worth asking whether leadership and relational resources are necessary for team outcomes, not only whether they are associated with them on average. In this sample, all four resources showed medium but modest necessity effects for team performance (d = 0.104 to 0.157), whereas for low TCR only SL and PS did, with TT marginal. Applications of Path–Goal Theory usually assume that leader behaviors compensate for one another additively. Our results raise the possibility that, for some outcomes, a low level of one resource may not be offset by a high level of another. We offer this as a proposition for longitudinal and multi-sample research, not as a boundary condition established by this study.

Finally, the study makes a methodological contribution to construction leadership research by examining servant and TL in a single model with two outcomes, and by combining sufficiency-based and necessity-based analysis, which remains uncommon in the field (Richter et al., 2020).

Expected Cross-Cultural Boundary Conditions

Every finding in this study comes from one national context. Below we distinguish patterns that rest on mechanisms we expect to operate across settings, including Western construction contexts, from patterns that may depend on features of the Chinese construction context, chiefly high-power distance, guanxi-based trust, and concern for face (mianzi).

The core direction of the SL/TL → PS/TT → outcome mediation pathways is grounded in Path–Goal Theory and Social Exchange Theory, both developed on and

repeatedly validated in Western samples; we would expect SL to be positively associated with PS and trust, and both mediators to be positively associated with performance and negatively associated with TCR, across cultural settings, including Western construction contexts, since these relationships depend on general reciprocity and uncertainty-reduction mechanisms rather than culture-specific processes.

By contrast, SL's advantage over TL may be smaller in lower-power-distance contexts. In high-power-distance settings, subordinates expect leaders to direct rather than to consult, so a leader who invites voice and puts followers' needs first departs from that expectation; servant behaviors may therefore send an unusually strong signal of benevolence and be a particularly effective route to PS and trust. In flatter organizational cultures, including many Western ones, employees are more likely to expect voice and empowerment as a baseline regardless of leadership style, so the same behaviors should carry less additional weight, narrowing SL's advantage over TL. This is consistent with our expectation, noted under the second implication above, that SL's advantage may be larger in this context than elsewhere. The trust pathway, which carried the smaller indirect effects in this sample, may also take a different form elsewhere. In Chinese business contexts, trust in a leader is built partly through guanxi-based personal relationships (Bian, 2018). Where trust rests more on formal, contractual, or institutional mechanisms, the predictability that TL provides may be a relatively more effective route to trust, which would again narrow SL's advantage.

The NCA necessity findings (that all four factors showed necessity effects for high performance in this sample) may likewise be partly a function of this sample's specific power-distance and face-saving dynamics, where the absence of any one of these resources (e.g., low psychological safety) may be more strongly inhibiting than in lower-power-distance cultures, where employees have other avenues (e.g., formal grievance channels or independent employee representation) to compensate for weak leader-level psychological safety. The necessity pattern for low TCR, which rested mainly on SL and PS, may be similarly context-dependent, because both concern members' willingness to raise problems with those above them, which is where power distance and face concerns bite hardest.

We recommend cross-national replication, ideally with measurement invariance testing, before treating any of these patterns as culturally universal.

7. Practical Implications

The implications below are tentative. The data are cross-sectional and self-reported, so they show associations rather than the effects of changing leadership behavior; they come from one national context, where high power distance and guanxi-based norms may shape how the two styles are received; and the model explains a modest share of the variance in the outcomes (R^2 = 0.31 for performance and 0.25 for TCR). The results indicate where leadership development may help, not how much a given project will improve. They should be tested in lower-power-distance settings before being applied elsewhere and are best treated as evidence-based starting points rather than definitive managerial directives.

SL showed the strongest associations with both outcomes. Development programs could therefore target the specific behaviors captured by the scale: noticing early when work is going wrong, giving team members discretion to handle difficult situations, and prioritizing members' development. Firms should expect marginal gains rather than a transformation in project results.

TL was positively associated with performance, so agreed targets, milestone tracking, and clear expectations remain useful. It showed no association with TCR, however, which suggests that tighter monitoring alone is unlikely to reduce friction or miscommunication-driven rework. Combining clear targets with SL behaviors is a more promising option than

choosing between them; how the mix should shift across project phases, for example with newly assembled subcontractor teams or high-risk work, is a question for future research.

PS showed the largest indirect effect for TCR and a necessity effect for low TCR. Project managers could build routines in which problems are raised without blame, for example, short daily coordination meetings where team members can flag unclear instructions, potential delays, or quality concerns, followed by visible action on the concerns raised.

Firms could survey teams at mobilization and at key milestones to identify teams with low PS or trust. The bottleneck tables show how to interpret such survey results. As an illustration from this sample, every respondent reporting performance at 90% of its observed range rated SL at or above roughly the sample median (55th percentile), and every respondent at the 90% level of low TCR (that is, close to the lowest observed) rated PS at or above roughly the 37th percentile (Table 10). A firm using the same scales could therefore treat teams below the median on servant leadership, or in the bottom third on psychological safety, as candidates for early support, such as coaching for the project manager or facilitated start-up sessions. We use the 90% level because estimates at the maximum rest on very few cases. These percentiles describe this sample only; firms should derive reference values from their own data before relying on them, should treat them as floors that make high outcomes possible rather than targets that guarantee them, and should not use survey results to judge individual managers.

Because leadership is only one of several influences on project outcomes (see Explanatory Reach in the Discussion), leadership development is best combined with project-level measures such as realistic schedule contingency, clear change-control procedures with the client, and adequate authority for project managers.

8. Limitations and Future Research

8.1. Causal Inference

All constructs (SL, TL, PS, TT, PTP, TCR) were measured at a single time point from the same respondent, so the design supports association, not causal inference. Reverse causality is plausible: high-performing teams (high PTP) may rate their leader as more servant-oriented after the fact rather than the leadership causing the performance, and low-conflict teams (low TCR) may simply find it easier to perceive trust and safety. Well-functioning teams may also attract servant-oriented leaders rather than being produced by them. The reported relationships should therefore be read as associations, not causal effects; longitudinal follow-up is essential, not optional, before making causal claims. The same caution applies to the mediation results. Estimating indirect effects from single-time-point data assumes that leadership precedes PS and trust and that these precede the outcomes; if the ordering runs partly the other way, the indirect effects may be over- or under-estimated. Because the same person rated leadership, relational climate, and outcomes, common-source variance may also inflate the associations. Future work should therefore use at least three measurement waves (leadership first, then PS and trust, then outcomes) to establish a temporal order for each stage of the mediation; a cross-lagged panel design to test whether team functioning also predicts later ratings of leadership; performance and rework data drawn from project records or from a second rater to remove the common-source link; and, where feasible, field interventions that train project managers in servant-leadership behaviors, compared against matched teams, which would provide the strongest test of a causal effect.

8.2. Other Limitations and Future Research

First, the study included only construction project teams in China, so the results may not be generalizable. The relationships observed may have been affected by cultural char-

acteristics such as high-power distance within the organization, hierarchical organizational structures, and mianzi (face). The proposed model should be further validated in other countries, industries, and cultural contexts.

Second, this study used PLS-SEM and NCA, but it did not apply the combined Importance–Performance Map Analysis (cIPMA). Future research could use cIPMA to identify underperforming essential constructs and offer more specific managerial priorities.

Third, the TCR construct was deliberately scoped to capture interpersonal friction and rework attributable to miscommunication and coordination breakdowns, rather than rework arising from technical error, design changes, or material problems. This choice aligns the construct with the study's focus on leadership and relational processes. However, it means the findings speak only to the relationally rooted subset of rework and should not be read as claims about rework more broadly. Future research could extend the model with a formative or multidimensional specification of rework that incorporates technical and design-driven sources alongside the relational pathway examined here, allowing a direct comparison of how much each source contributes independently to project outcomes. Item TCR5 asks whether tasks must be redone "due to errors or misunderstandings"; the reference to errors means that the item may also capture some technically caused rework, which slightly blurs this scope boundary. The conflict items also combine relationship conflict (TCR4, TCR6) with task and process conflict (TCR1, TCR3). Because the two types can have different and even opposite effects on teams (De Dreu & Weingart, 2003), and leadership styles may influence them differently (clear goals, for example, may reduce process conflict while close monitoring heightens interpersonal tension), future studies should measure them as separate constructs.

We did not measure subcontractor familiarity, task hazard level, or worker experience, and our TL scale combined contingent reward, monitoring, and corrective action (which may relate to PS in opposite ways, since attention to mistakes can raise the perceived cost of speaking up while clear goals lower it), so the situational trade-offs discussed above remain untested. Future studies should separate these components and test them against such contextual moderators. In addition, although the TT scale covers both cognition-based (TT1–TT4) and affect-based (TT5–TT8) trust, we modeled TT as a single construct, so we did not test the two components separately; doing so would directly test the pathway argument developed above. TT was also measured with the project manager as referent, so trust among peers, which may matter more for relational conflict, was not captured; future studies should measure both. The necessity result for TT and low TCR was borderline ($p = 0.047$) and should be replicated.

Because data were collected from individual respondents without team identifiers, PS and TT were analyzed as individual perceptions rather than aggregated team properties, and team processes such as coordination, communication, and knowledge sharing, which require multi-member team data, were not measured. Direct effects accounted for 61–64% of each leadership style's total association with performance, a share that unmeasured team processes and identity-based mechanisms may partly explain. Future research using nested team designs should test team identification and team processes alongside PS and trust, ideally in a serial model (leadership → emergent states → team processes → outcomes), to establish their relative and sequential contributions.

Finally, as discussed under Explanatory Reach, the model leaves most of the variance in the outcomes unexplained, and this study considered only PS and TT as mediating mechanisms. Future studies should incorporate additional mediators, such as team cohesiveness, quality of communication, knowledge sharing, resilience, and agility, as well as contextual factors such as project complexity, organizational support, client stability,

labor-market conditions, and cultural values, to better understand how leadership relates to project outcomes in diverse construction environments.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/pmh1020007/s1, Table S1: Effects of the control variables on the outcome constructs; Table S2: Hypothesis tests with and without the control variables; Table S3: Moderation tests: PM/APM role and team size on the twelve structural paths; Table S4: Discriminant Validity of Psychological Safety and Team Trust: Measurement Model Comparison; Table S5: Unidimensionality of Team Conflict/Rework (TCR): Measurement Model Comparison and Conflict-Only Robustness Model; Table S6: Comparison of Specific Indirect Effects through Psychological Safety and Team Trust.

Author Contributions: X.L. provided valuable insights into the theoretical framework, conceptualization, resources, supervision, validation, and proofreading; S.B. made significant contributions to the conception and design of the study, writing the original draft, data collection, analysis, and interpretation; A.H.K. contributed to developing the study design, interpretation, and proofreading; N.R. contributed to the interpretation of the study findings and to reviewing and editing the manuscript; A.M. assisted with data collection and proofreading. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethical approval: This study involved human participants who completed an anonymous questionnaire. Prior to data collection, the study protocol was reviewed by the Academic Ethics Committee of Business School, Sichuan University. The Board determined that the study qualified for exemption from full ethical review because it involved minimal-risk survey research with adult participants and did not collect personally identifiable or sensitive information. The participants were all adults who were not members of vulnerable groups. The questionnaire did not include highly sensitive questions or procedures that were expected to expose participants to more than minimal psychological, social, or physical risk. No deception was used, and participants were provided with appropriate information about the purpose and procedures of the study before participation. All collected data were anonymous and accessible only to the research team.

Informed Consent Statement: The requirement for signed written informed consent was waived by the Institutional Review Board/Ethics Committee because the study involved an anonymous, minimal-risk questionnaire, and obtaining signatures would have created an unnecessary link between participants and their responses. Before beginning the questionnaire, participants were presented with an informed consent statement explaining the purpose of the study, the voluntary nature of participation, confidentiality and anonymity protections, their right to decline participation or discontinue the questionnaire without penalty, and the intended use of the collected data. Participants indicated their consent by voluntarily proceeding to complete and submit the questionnaire. The consent procedure and waiver of signed consent were reviewed and approved by the Institutional Review Board/Ethics Committee of Sichuan University.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Acknowledgments: We extend our sincere appreciation to all who contributed to this manuscript. Their commitment, expertise, and steadfast support were vital to the success of this research.

Conflicts of Interest: Author Ahmad Hassan Khalid was employed by Dongfang Turbine Co., Ltd. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SL	Servant Leadership
TL	Transactional Leadership
PS	Psychological Safety
TT	Team Trust
PTP	Project Team Performance
TCR	Team Conflict/Rework
NCA	Necessary Condition Analysis

Appendix A

Table A1. Demographic and Project Characteristics of Survey Respondents, and Measurement Structure and Item Wording.

Characteristic	Category	n	%
Role	Site Engineer	122	21.1%
	Contractor/Subcontractor Staff	110	19.0%
	Project Manager/Assistant PM	101	17.4%
	Project Coordinator	91	15.7%
	Quantity Surveyor/Cost Engineer	62	10.7%
	Architect/Design Team Member	60	10.4%
	Other	33	5.7%
Gender	Male	428	73.9%
	Female	127	21.9%
	Prefer not to say	24	4.1%
Age Group	18–25	51	8.8%
	26–35	190	32.8%
	36–45	183	31.6%
	46–55	98	16.9%
	56+	57	9.8%
Experience	<2 Years	76	13.1%
	2–5 Years	169	29.2%
	6–10 Years	150	25.9%
	11–15 Years	103	17.8%
	>15 Years	81	14.0%
Project Type	Residential	174	30.1%
	Commercial	170	29.4%
	Infrastructure	135	23.3%
	Industrial	100	17.3%
Delivery Method	DBB	224	38.7%
	DB	141	24.4%
	CMAR	106	18.3%
	IPD	71	12.3%
	Not sure/Other	37	6.4%
Project Phase	Execution/Construction	325	56.1%
	Planning/Design	143	24.7%
	Closeout/Handover	111	19.2%
Team Size	Mean (SD)	14.2	-
	Median	14	-
	Range	3–31	-

Table A1. *Cont.*

Measurement Structure and Item Wording	
Code	**Item**
	Servant Leadership
SL1	My project manager can tell if something work-related is going wrong.
SL2	My project manager prioritizes my career development.
SL3	My project manager encourages team members to be involved in community and volunteer activities.
SL4	My project manager puts my best interests ahead of their own.
SL5	My project manager gives me the freedom to handle difficult situations in the way I feel is best.
SL6	My project manager emphasizes the importance of giving back to the community.
SL7	My project manager puts the team's needs above their own personal agenda.
	Transactional Leadership
TL1	My project manager focuses attention on irregularities, mistakes, exceptions, and deviations from standards.
TL2	My project manager closely tracks my performance against milestones and schedules.
TL3	My project manager makes clear what I can expect in return for my effort on tasks.
TL4	My project manager takes corrective action as soon as problems become visible.
TL5	My project manager and I agree on specific goals/targets and how we will measure them.
	Psychological Safety
PS1	On this project, if I make a mistake, it is not held against me.
PS2	Members of my project team can raise safety or quality concerns without fear of negative consequences.
PS3	No one on this team would deliberately undermine my efforts.
PS4	It is safe to take a risk (e.g., suggest a new method or flag a potential delay) on this project.
PS5	My unique skills and talents are valued and utilized on this project.
	Team Trust (in the project manager): TT1–TT4 cognition-based; TT5–TT8 affect-based
TT1	My project manager approaches their job with professionalism and dedication.
TT2	Given my project manager's track record, I see no reason to doubt their competence and preparation for the job.
TT3	I can rely on my project manager not to make my job harder through careless work.
TT4	Most people, even those who are not close to my project manager, trust and respect them as a colleague.
TT5	I can talk freely to my project manager about difficulties I am having at work and know they will listen.
TT6	My project manager and I have a sharing relationship—we can both freely share our ideas, feelings, and hopes.
TT7	If I shared my problems with my project manager, I know they would respond constructively and caringly.
TT8	I would characterize my working relationship with my project manager as one built on mutual respect.
	Project Team Performance
Dimension 1	*Schedule Performance*
SCH1	My project team consistently meets planned milestones on schedule.
SCH2	Delays on this project are identified and addressed quickly.
SCH3	The pace of work on this project matches the project schedule.
Dimension 2	*Cost Performance*
CST1	My project team keeps work within the allocated budget.
CST2	Cost overruns on this project are rare.
CST3	Resources (materials, labor, equipment) are used efficiently on this project.
Dimension 3	*Quality Performance*
QLT1	The quality of work my team delivers meets or exceeds project specifications.
QLT2	Rework due to quality issues is minimal on this project.
QLT3	Client/stakeholder satisfaction with work quality is high on this project.
Dimension 4	*Safety Performance*
SAF1	My project team consistently follows established safety protocols and procedures.
SAF2	Safety incidents and near-misses are rare on this project.
SAF3	My project team identifies and corrects safety hazards promptly.

Table A1. *Cont.*

Measurement Structure and Item Wording	
Code	**Item**
	Team Conflict/Rework
TCR1	Frequent friction or disagreement among members of my project team.
TCR2	Rework caused by miscommunication or unclear instructions is common on this project.
TCR3	Conflicting priorities between team members often slow down our work.
TCR4	Personal conflicts between team members negatively affect this project's progress.
TCR5	Tasks on this project often have to be redone due to errors or misunderstandings.
TCR6	Disputes on this project tend to escalate rather than get resolved quickly.

References

Abbas, M., & Ali, R. (2023). Transformational vs. transactional leadership styles and project success: A meta-analytic review. *European Management Journal*, *41*(1), 125–142. [CrossRef]

Altaher, A. M., AL-Obaidly, G. A., Al-badaineh, G., Kashoob, S. S. M., Hammouri, Q., & Khasawneh, M. A. S. (2024). The impact of leadership styles on project success: The mediating role of team collaboration. *Journal of Project Management*, *9*(4), 485–492. [CrossRef]

Atkinson, R. (1999). Project management: Cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management*, *17*(6), 337–342. [CrossRef]

Bass, B. M. (1985). *Leadership and performance beyond expectations* (Vol. 25). Free Press.

Bass, B. M., & Avolio, B. J. (1995). *MLQ Multifactor Leadership Questionnaire: Technical report, leader form and scoring key for MLQ Form 5X-Short* (pp. 7–19) [Technical report]. Binghamton University. [CrossRef]

Bian, Y. (2018). The prevalence and the increasing significance of guanxi. *The China Quarterly*, *235*, 597–621. [CrossRef]

Blau, P. M. (1964). Justice in social exchange. *Sociological Inquiry*, *34*(2), 193–206. [CrossRef]

Brislin, R. W. (1970). Back-translation for cross-cultural research. *Journal of Cross-Cultural Psychology*, *1*(3), 185–216. [CrossRef]

Chan, A. P. C., & Chan, A. P. L. (2004). Key performance indicators for measuring construction success. *Benchmarking: An International Journal*, *11*(2), 203–221. [CrossRef]

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *9*(2), 233–255. [CrossRef] [PubMed]

Clarke, S. (2013). Safety leadership: A meta-analytic review of transformational and transactional leadership styles as antecedents of safety behaviours. *Journal of Occupational and Organizational Psychology*, *86*(1), 22–49. [CrossRef]

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). L. Erlbaum Associates.

Cropanzano, R., & Mitchell, M. S. (2005). Social exchange theory: An interdisciplinary review. *Journal of Management*, *31*(6), 874–900. [CrossRef]

De Dreu, C. K. W., & Weingart, L. R. (2003). Task vs. relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology*, *88*(4), 741–749. [CrossRef] [PubMed]

De Jong, B. A., Dirks, K. T., & Gillespie, N. (2016). Trust and team performance: A meta-analysis of main effects, moderators, and covariates. *Journal of Applied Psychology*, *101*(8), 1134–1150. [CrossRef] [PubMed]

Detert, J. R., & Burris, E. R. (2007). Leadership behavior and employee voice: Is the door really open? *Academy of Management Journal*, *50*(4), 869–884. [CrossRef]

Dul, J. (2016). Identifying single necessary conditions with NCA and fsQCA. *Journal of Business Research*, *69*(4), 1516–1523. [CrossRef]

Dul, J., Hauff, S., & Bouncken, R. B. (2023). Necessary condition analysis (NCA): Review of research topics and guidelines for good practice. *Review of Managerial Science*, *17*(2), 683–714. [CrossRef]

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, *44*(2), 350–383. [CrossRef]

Frazier, M. L., Fainshmidt, S., Klinger, R. L., Pezeshkan, A., & Vracheva, V. (2017). Psychological safety: A meta-analytic review and extension. *Personnel Psychology*, *70*(1), 113–165. [CrossRef]

Greenleaf, R. K. (1970). *The servant as leader*. Center for Applied Studies.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook*. Springer International Publishing. [CrossRef]

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. [CrossRef]

Han, H., Ma, C., Yang, D., & Zhao, W. (2025). Transformational leadership and project success: The mediating roles of team reflexivity and project team resilience. *Frontiers in Psychology*, *16*, 1504108. [CrossRef]

Han, H., Ma, F., & Liu, X. (2024). Transformational leadership and project success: The serial meditating roles of team flexibility and team agility. *Frontiers in Built Environment*, *9*, 1334413. [CrossRef]

Han, H., & Zhang, X. (2024). Servant leadership and project success: The mediating roles of team learning orientation and team agility. *Frontiers in Psychology*, *15*, 1417604. [CrossRef]

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: Updated guidelines. *Industrial Management & Data Systems*, *116*(1), 2–20. [CrossRef]

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. [CrossRef]

Hogg, M. A. (2001). A social identity theory of leadership. *Personality and Social Psychology Review*, *5*(3), 184–200. [CrossRef]

House, R., & Mitchel, R. (1974). Path-goal theory of leadership. *Journal of Contemporary Business*, *3*, 81–98.

House, R. J. (1971). A path goal theory of leader effectiveness. *Administrative Science Quarterly*, *16*(3), 321–338. [CrossRef]

Hwang, K. (1987). Face and favor: The Chinese power game. *American Journal of Sociology*, *92*(4), 944–974. [CrossRef]

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annual Review of Psychology*, *56*(1), 517–543. [CrossRef]

Jabbar, A. L., & Khoiry, M. A. (2025). Construction delays and project profitability: A systematic review. *Proceedings of the Institution of Civil Engineers—Management, Procurement and Law*. Advance online publication. [CrossRef]

Jarvis, C. B., MacKenzie, S. B., & Podsakoff, P. M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of Consumer Research*, *30*(2), 199–218. [CrossRef] [PubMed]

Jehn, K. A. (1995). A multimethod examination of the benefits and detriments of intragroup conflict. *Administrative Science Quarterly*, *40*(2), 256–282. [CrossRef]

Jehn, K. A., & Mannix, E. A. (2001). The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance. *Academy of Management Journal*, *44*(2), 238–251. [CrossRef]

Joo, B.-K., Yoon, S. K., & Galbraith, D. (2023). The effects of organizational trust and empowering leadership on group conflict: Psychological safety as a mediator. *Organization Management Journal*, *20*(1), 4–16. [CrossRef]

Judge, T. A., & Piccolo, R. F. (2004). Transformational and transactional leadership: A meta-analytic test of their relative validity. *Journal of Applied Psychology*, *89*(5), 755–768. [CrossRef]

Kerr, S., & Jermier, J. M. (1978). Substitutes for leadership: Their meaning and measurement. *Organizational Behavior and Human Performance*, *22*(3), 375–403. [CrossRef]

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration*, *11*(4), 1–10. [CrossRef]

Kramer, R., & Tyler, T. (1996). *Trust in organizations: Frontiers of theory and research*. SAGE Publications, Inc. [CrossRef]

Lewicki, R., & Bunker, B. (1996). Developing and maintaining trust in working relations. In *Trust in organizations: Frontiers of theory and research* (pp. 114–139). [CrossRef]

Li, X., Li, H., Zhang, R., Yin, Y., Sun, S., Bai, J., & Liu, R. (2024). Impact of asymmetric trust on construction project management performance: The mediating role of knowledge sharing. *Engineering, Construction and Architectural Management*, *31*(11), 4538–4561. [CrossRef]

Liden, R. C., Wayne, S. J., Liao, C., & Meuser, J. D. (2014). Servant leadership and serving culture: Influence on individual and unit performance. *Academy of Management Journal*, *57*(5), 1434–1452. [CrossRef]

Liden, R. C., Wayne, S. J., Zhao, H., & Henderson, D. (2008). Servant leadership: Development of a multidimensional measure and multi-level assessment. *The Leadership Quarterly*, *19*(2), 161–177. [CrossRef]

Liengaard, B. D., Sharma, P. N., Hult, G. T. M., Jensen, M. B., Sarstedt, M., Hair, J. F., & Ringle, C. M. (2021). Prediction: Coveted, yet forsaken? Introducing a cross-validated predictive ability test in partial least squares path modeling. *Decision Sciences*, *52*(2), 362–392. [CrossRef]

Love, P. E. D., Edwards, D. J., & Smith, J. (2016). Rework causation: Emergent theoretical insights and implications for research. *Journal of Construction Engineering and Management*, *142*(6), 04016010. [CrossRef]

Lundin, R. A., & Söderholm, A. (1995). A theory of the temporary organization. *Scandinavian Journal of Management*, *11*(4), 437–455. [CrossRef]

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *The Academy of Management Review*, *26*(3), 356–376. [CrossRef] [PubMed]

Mathieu, J., Maynard, M. T., Rapp, T., & Gilson, L. (2008). Team effectiveness 1997–2007: A review of recent advancements and a glimpse into the future. *Journal of Management*, *34*(3), 410–476. [CrossRef]

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *The Academy of Management Review*, *20*(3), 709–734. [CrossRef]

McAllister, D. J. (1995). Affect- and cognition-based trust as foundations for interpersonal cooperation in organizations. *Academy of Management Journal*, *38*(1), 24–59. [CrossRef]

Meng, Q., Liu, W., Li, Z., Chong, H.-Y., & Li, K. (2026). Mindful leadership and construction workers' safety citizenship behavior: A moderated mediation model of team psychological safety, participative safety self-efficacy, and leader–member exchange. *Journal of Construction Engineering and Management*, *152*(2), 04025244. [CrossRef]

Nauman, S., Basit, A. A., Munir, H., & Iqbal, M. S. (2024). When and how servant leadership leads to megaproject success: The roles of project governance and interpersonal trust. *Project Management Journal*, *55*(3), 297–312. [CrossRef]

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology*, *91*(4), 946–953. [CrossRef]

Newaz, M. T., Wang, D., Davis, P., Wang, X., Jefferies, M., & Sheng, Z. (2021). A cross-cultural validation of the psychological contract of safety on construction sites. *Safety Science*, *141*, 105360. [CrossRef]

Nitzl, C., Roldan, J. L., & Cepeda, G. (2016). Mediation analysis in partial least squares path modeling: Helping researchers discuss more sophisticated models. *Industrial Management & Data Systems*, *116*(9), 1849–1864. [CrossRef]

Olasunkanmi, F. O., Ikediashi, D. I., & Ajiero, I. R. (2024). Assessing the factors of transactional leadership style for construction projects: A case of Nigerian construction industry. *Journal of Engineering, Design and Technology*, *22*(5), 1637–1654. [CrossRef]

Papadonikolaki, E., & Morgan, B. (2026). Leading psychologically safe digitally enabled project teams. *Project Management Journal*, *57*(2), 170–187. [CrossRef]

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903. [CrossRef] [PubMed]

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*(3), 879–891. [CrossRef] [PubMed]

Richter, N. F., Schubring, S., Hauff, S., Ringle, C. M., & Sarstedt, M. (2020). When predictors of outcomes are necessary: Guidelines for the combined use of PLS-SEM and NCA. *Industrial Management & Data Systems*, *120*(12), 2243–2267. [CrossRef]

Ringle, C. M., Wende, S., & Becker, J. M. (2024). *SmartPLS 4* (Version 4) [Computer software]. Available online: https://www.smartpls.com (accessed on 13 January 2026).

Rousseau, D. M., Sitkin, S. B., Burt, R. S., & Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of Management Review*, *23*(3), 393–404. [CrossRef]

Sarstedt, M., Hair, J. F., Cheah, J.-H., Becker, J.-M., & Ringle, C. M. (2019). How to specify, estimate, and validate higher-order constructs in PLS-SEM. *Australasian Marketing Journal*, *27*(3), 197–211. [CrossRef]

Sharma, P. N., Liengaard, B. D., Hair, J. F., Sarstedt, M., & Ringle, C. M. (2023). Predictive model assessment and selection in composite-based modeling using PLS-SEM: Extensions and guidelines for using CVPAT. *European Journal of Marketing*, *57*(6), 1662–1677. [CrossRef]

Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J.-H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: Guidelines for using PLSpredict. *European Journal of Marketing*, *53*(11), 2322–2347. [CrossRef]

Shore, L. M., Tetrick, L. E., Lynch, P., & Barksdale, K. (2006). Social and economic exchange: Construct development and validation. *Journal of Applied Social Psychology*, *36*(4), 837–867. [CrossRef]

Siddiquei, A. N., Ahmad, S., & Asmi, F. (2025). Fostering team resilience with servant leadership: A multi-level study of the construction industry. *Acta Psychologica*, *253*, 104732. [CrossRef]

Thuy, D. T. T., & Anh, T. T. (2024). Linking transformational leadership and project success: Role of work engagement and project complexity. *Journal of Eastern European and Central Asian Research (JEECAR)*, *11*(2), 320–331. [CrossRef]

Van Dierendonck, D. (2011). Servant leadership: A review and synthesis. *Journal of Management*, *37*(4), 1228–1261. [CrossRef]

Van Knippenberg, D., & Hogg, M. A. (2003). A social identity model of leadership effectiveness in organizations. *Research in Organizational Behavior*, *25*, 243–295. [CrossRef]

Wang, L., Luo, X., Li, H., & Chen, H. (2025). The impact of foremen's paternalistic leadership on construction workers' safety behaviors: Considering the effects of team safety climate, workers' psychological safety and power distance. *Frontiers in Public Health*, *13*, 1633467. [CrossRef] [PubMed]

Young, H. R., Glerum, D. R., Joseph, D. L., & McCord, M. A. (2021). A meta-analysis of transactional leadership and follower performance: Double-edged effects of LMX and empowerment. *Journal of Management*, *47*(5), 1255–1280. [CrossRef]

Yunpeng, G., & Zaman, U. (2024). Exploring mega-construction project success in China's vaunted Belt and Road Initiative: The role of paternalistic leadership, team members' voice and team resilience. *Engineering, Construction and Architectural Management*, *31*(9), 3801–3825. [CrossRef]

Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197–206. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.