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Trust and communication in supervisor-subordinate relationships in technology-intensive business sectors in China

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Effective communication between superiors and subordinates is critical to operational efficiency in technology-intensive industries, yet trust deficits and interpersonal barriers often disrupt this dynamic. Despite their impact, such communication challenges remain insufficiently addressed in these sectors. This research addressed these gaps, exploring key factors from three distinct perspectives: the influence of superiors' transformational leadership, the self-efficacy of subordinates, and the level of mutual trust between superiors and subordinates. The study analyzed how these elements shape communication dynamics. It constructed models to illustrate these relationships and supported its findings with empirical data to validate the proposed hypotheses. Additionally, the study employed chain mediation analysis to deepen the understanding of these influence pathways. It used a structural equation model based on questionnaire data collected in 2023 in China. The findings revealed a strong positive correlation between trust and effective communication between superiors and subordinates. The research further demonstrated that self-efficacy and transformational leadership serve as chain mediators in this dynamic. Notably, transformational leadership emerged as a crucial mediator between trust and communication effectiveness. By combining theoretical frameworks with empirical insights, this study offers a comprehensive analysis of the factors that shape superior-subordinate communication. It filled existing knowledge gaps but also provided practical recommendations to improve workplace relationships. It also suggested effective approaches to fostering better communication within organizations.

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Introduction

Amid intense market competition, technology-driven business sectors in China are increasingly dependent on strong supervisor-subordinate relationships to sustain organizational flexibility and foster innovation (Abid et al. 2024; Muisyo et al. 2022; Saks 2022). Nonetheless, these vital relationships are often strained by communication challenges that hinder managerial effectiveness and reduce employee engagement (Li et al. 2022; Messmann et al. 2022; Mujtaba & Naz 2025). In this context, trust plays a crucial role in shaping communication dynamics between supervisors and subordinates (Kanat-Maymon et al. 2020; Li et al. 2023; Lim & Moon 2020). Trust is dynamic, evolving through interaction and shared experiences (Siangcho-kyoo et al. 2020; Siswanto & Yuliana 2022). It significantly impacts behavior, cooperation, and relational stability at work (Gillath et al. 2021; Sweijen et al. 2023; Hancock et al. 2023).

Previous research confirmed that trust positively influences performance and self-efficacy (Addison & Teixeira 2020; Ilyas et al. 2020; Legood et al. 2021), which are both crucial for fostering effective communication. Self-efficacy, in turn, impacts employees' confidence, emotional responses, and their willingness to engage in workplace dialog (Han & Bai 2020; Na-Nan et al. 2021). As human-centered management becomes increasingly prominent, these psychological mechanisms deserve further empirical investigation (Christensen-Salem et al. 2021; Gu et al. 2024).

In technology-intensive industries characterized by complex and rapidly evolving environments (Lin et al. 2025), cultivating trust between supervisors and subordinates significantly enhances transparent knowledge exchange and accelerates problem-solving (Wang et al. 2025). Establishing a culture of trust mitigates informational bottlenecks, reduces communication costs, and fosters open dialog, all of which are essential for ongoing innovation (Johnson & Rickard 2023; Zeng et al. 2025).

Transformational leadership, which includes personal support, charm, and a strong vision, has been proven to greatly affect how trust is built and how communication works (Gao et al. 2020; Shafi et al. 2020; Yang et al. 2020). Transformational leaders play a pivotal role in shaping employee self-efficacy, inspiring proactive engagement, and fostering effective supervisor-subordinate interactions (Yuan et al. 2022; Zainab et al. 2022). Despite growing interest in these constructs, research that integrates trust, communication, transformational leadership, and self-efficacy within technology-intensive contexts remains limited. Most existing studies examine these variables in isolation (Le & Nguyen 2023; McLarty et al. 2021; Santa et al. 2023), with insufficient attention to the mechanisms that connect them. Importantly, the roles of transformational leadership and self-efficacy in the trust–communication relationship have not been studied enough, especially in Chinese organizations where strict hierarchies exist alongside fast technological changes.

To address these gaps, this study proposes a chain mediation model to explore how trust enhances communication through the mediating roles of transformational leadership and self-efficacy. Specifically, it aims to answer the following research questions: (1) How does trust between supervisors and subordinates affect communication effectiveness in China's technology-intensive industries? (2) What role does transformational leadership play in moderating the trust–communication dynamic? (3) How does employee self-efficacy impact subordinate responsiveness and proactive dialog? (4) Can transformational leadership and self-efficacy sequentially mediate the trust–communication relationship? By empirically examining these interrelations, this study contributes to the theoretical advancement of workplace communication research. It provides practical insights into improving managerial effectiveness, boosting employee engagement, and

fostering high-performance organizational cultures. These findings are particularly relevant for technology-driven firms seeking trust-based, innovation-oriented environments.

Literature review and hypotheses

Organizational communication emphasizes the pivotal role of trust. Defined as an individual's confidence in another's reliability and integrity (Hancock et al. 2023), trust bridges gaps in collaboration, reduces information asymmetry, and fosters open dialog—key ingredients for thriving teams (Yin et al. 2020). When employees trust their leaders, they engage more freely: sharing insights, offering candid feedback, and committing to collective goals (Yuan et al. 2022). In technology-intensive industries, where complex projects demand rapid knowledge exchange, trust becomes even more critical (Johnson and Rickard 2023). Consider the development of software or artificial intelligence like DeepSeek and ChatGPT. Teams rely on transparent communication to navigate complex workflows and avoid costly misunderstandings. Trust is not merely a desirable attribute; it drives efficiency and innovation (Christensen-Salem et al. 2021). Transformational leadership amplifies this dynamic. Leaders who inspire through vision and empathy cultivate environments where trust flourishes (Khan et al. 2020). By empowering employees and aligning their goals with organizational missions, such leaders boost trust directly and nurture self-efficacy—the belief in one's ability to tackle challenges (McLarty et al. 2021). In the fast-paced tech sector, this leadership style is indispensable. Teams need to pivot swiftly amid market shifts, and transformational leaders equip them with the confidence to adapt (Siswanto & Yuliana 2022). Self-efficacy, in turn, strengthens communication. Employees who trust their capabilities contribute more proactively, driving both individual and collective success (Kanat-Maymon et al. 2020). In tech-driven fields, where expertise and creativity are paramount, this self-assurance fuels innovation and reduces burnout (Li & Xiao 2023). Yet, despite these connections, research often isolates factors like trust, leadership, or self-efficacy, leaving their combined impact underexplored—especially in empirical terms (Santa et al. 2023).

This gap is striking. Tech industries thrive on synergy, yet studies rarely examine how trust, transformational leadership, and self-efficacy interact. For instance, while transformational leadership's role in fostering trust is acknowledged, its interplay with self-efficacy as a mediator remains unclear (Kanat-Maymon et al. 2020; Siswanto & Yuliana 2022). Similarly, although trust reduces information barriers (Qian et al. 2020), how it shapes communication through leadership and self-belief demands deeper inquiry (Matsunaga 2021). Chain mediation offers clarity. Imagine trust as the spark: leaders who act with integrity and empathy earn their team's confidence (Sweijen et al. 2023). This trust then fuels transformational practices—vision-setting, mentorship, and psychological safety—which bolster employees' self-efficacy (Li & Xiao 2023). Confident employees communicate more openly, creating a feedback loop that enhances collaboration and project outcomes (Miao et al. 2020). In the tech sector, this virtuous cycle is vital. Transformational leaders bridge hierarchical gaps, fostering loyalty and reducing turnover (Yuan et al. 2022). Meanwhile, self-efficacy drives knowledge-sharing and resilience, mitigating burnout and strengthening leader-subordinate bonds (Yin et al. 2020). Teams that exhibit faster innovation, smarter adaptation, and seamless communication—even under pressure—are more effective. The following analysis details and clarifies this chain mediation model.

Superiors-subordinates trust. A stable trust relationship between superiors and subordinates within an organization supports steady progress in organizational processes and initiatives, enhances team cohesion, and helps maintain positive internal relationships (Siswanto and Yuliana 2022). This foundation of trust facilitates more effective communication between leaders and employees. When superiors demonstrate confidence in their subordinates' abilities, and subordinates, in turn, trust their superiors' decisions, loyalty to the organization increases, leading to higher overall job satisfaction (Han & Bai 2020). Sufficient trust between superiors and subordinates encourages employees to offer constructive suggestions, assists leaders in making well-informed decisions, and strengthens interpersonal connections (Gao et al. 2020). These dynamics foster open and honest communication, facilitating efficient information flow and prompt issue resolution (Yang et al. 2020). When superiors fully trust their subordinates, they can delegate authority without excessive oversight, reducing management costs and increasing efficiency (Shafi et al. 2020). This empowerment, in turn, enables employees to take an active initiative. Likewise, when employees trust their superiors, they are more likely to perform tasks loyally, which enhances organizational commitment and reduces turnover (Messmann et al. 2022). A holistic view of this relationship shows that trust shared between leaders and employees extends beyond work-related interactions, fostering closer psychological connections (Miao et al. 2020; Nienaber et al. 2023). Such trust helps employees adapt to change, confident that their superiors can navigate challenges effectively (Bedford 2022; Cheng et al. 2024). Based on this reasoning, we propose the following hypothesis:

H1: Superior-subordinate trust has a significant positive predictive effect on communication between them (trust → communication).

Transformational leadership style. Research on transformational leadership continues to be a major focus among scholars, highlighting its crucial role in advancing corporate management (Chen et al. 2022). Transformational leadership fosters a collaborative and inclusive approach to decision-making, encouraging organizational transformation, professional empowerment, and innovative change (Siangchokkyoo et al. 2020). This leadership style fully engages employees in proactive behaviors and shows genuine care for their well-being, which reduces emotional distance and strengthens trust between superiors and subordinates (Lim & Moon 2020). In turn, strong dynamic trust enables leaders to delegate authority with increasing confidence, encouraging employees to respond thoughtfully and constructively to leadership decisions (Men et al. 2020). This reciprocal trust creates a virtuous cycle within the organization. Transformational leadership also unlocks employees' potential, helping them recognize and leverage their capabilities effectively (Kanat-Maymon et al. 2020). Moreover, by focusing on personal growth and development, this leadership style enhances job satisfaction and engagement. As a result, transformational leaders tend to be more open and transparent, fostering effective communication and timely problem resolution within the organization (Khan et al. 2020). Based on this analysis, we propose the following hypotheses:

H2a: There is a positive correlation between transformational leadership style and communication between superiors and subordinates.

H2b: Transformational leadership style has a significant mediating effect between superior-subordinate trust and communication (trust → transformational leadership style → communication).

Self-efficacy. Contemporary management practices prioritize delegating authority to employees, fostering self-leadership (Hirschi & Koen 2021). This approach boosts employees' self-motivation and empowers them to self-direct their efforts. By enhancing employees' self-efficacy, leaders increase their willingness to offer suggestions, positively influencing their behavior and enabling leaders to make more informed decisions (Newman et al. 2018). Self-efficacy reflects employees' sense of competence in their roles, shaping their positive attitudes and emotions, which support the company projects' steady execution (Zhou & Zheng 2024). Self-directed motivation promotes better performance, encouraging managers to trust their employees. As a result, employees become more proactive, fueled by the trust and authority granted by their superiors, which strengthens their organizational loyalty (Cooke & Xu 2024). Individuals with high self-efficacy recover quickly from setbacks, contributing to organizational resilience. They are also more likely to build positive relationships and improve their communication skills. Leaders who demonstrate high self-efficacy show confidence in decision-making and effectively assess risks and opportunities (Schyns et al. 2020). Based on this analysis, we propose the following hypotheses for empirical testing:

H3a: Self-efficacy positively affects communication between superiors and subordinates.

H3b: Self-efficacy has a significant mediating effect between superior-subordinate trust and communication (trust → self-efficacy → communication).

Joint action of dual subjective initiatives. Some scholars suggest that transformational leadership enhances employees' motivation and sense of achievement by fostering self-confidence, self-efficacy, and self-esteem, which contribute to improved performance and stronger team cohesion (Yin et al. 2020). Transformational leadership style during decision-making processes is a predictor of both job satisfaction and performance. Consequently, leaders with higher self-efficacy are more likely to adopt transformational leadership styles (Vila-Vázquez et al. 2024). Research also indicates that transformational leadership stimulates employees' stewardship behaviors, fostering a sense of belonging and self-approval, which in turn enhances self-efficacy and strengthens employees' loyalty, enthusiasm, and engagement in their work (Na-Nan et al. 2021; Tian & Guo 2022). Given the chain mediating effects of both transformational leadership styles and self-efficacy (Fig. 1), we propose the following hypothesis:

H4: There is a chain mediating effect of transformational leadership and self-efficacy between superior-subordinate trust

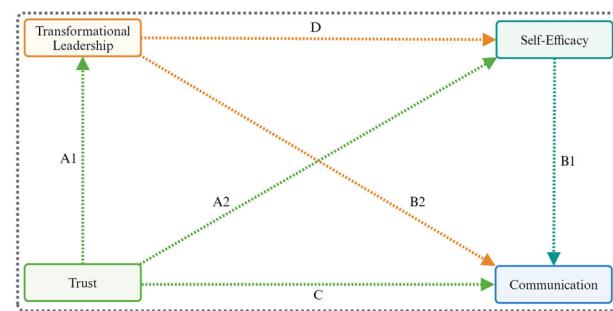


Fig. 1 The theoretical framework diagram illustrates the factors that influence communication. This includes the connection between trust—specifically between superiors and subordinates—and its impact on communication. The developed diagram showcases the mediating roles of transformational leadership and self-efficacy, along with a chain mediation effect that illustrates the relationship between transformational leadership style and self-efficacy.

and communication (trust → transformational leadership style → self-efficacy → communication).

Materials and methods

Unit of analysis. In this study, all sample measures, including trust and self-efficacy, are perception indices at the individual level. While organizations as entities do not communicate directly, individual members within these organizations engage in behaviors that reflect organizational communication dynamics. To facilitate analysis at both the dynamic and organizational levels, we assume that individuals' perceptions of communication-related issues are functions of interpersonal variables (Castañer & Oliveira 2020; Cepa 2021). Specifically, we examine four variables: trust between superiors and subordinates (an independent variable), communication between superiors and subordinates (a dependent variable), and transformational leadership style and self-efficacy (chain mediating variables). Recognizing that superiors and subordinates may hold divergent views on these variables, we included positional information in the questionnaire to enable a more comprehensive analysis. Data collection was conducted online using Questionnaire Star, a widely utilized platform in China known for its reliability and validity (Liu et al. 2022; Liu et al. 2020; Pan et al. 2023).

Data collection. The sample was composed of employees and managers from various regions across China (Fig. 2). Data collection was conducted in Chinese technology-intensive business sectors in 2023. This involved distributing questionnaires for respondents to complete via scanning and filling out. All four variables were measured on a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree" (Zhao et al. 2021). To enhance response rates, we adhered to Dillman's Total Design Method (Cariveau et al. 2020; Cuadros et al. 2021; Kmetty & Stefkovics 2022) in questionnaire modifications. Data collection was exclusively conducted through the Questionnaire Star application (Liu et al. 2022). This yielded 244 responses, of which 235 were valid, resulting in a 96.3% response rate (Table A1). The final sample included 166 employees (70.6%), 31 frontline managers (13.2%), 31 middle managers (13.2%), and 7 senior managers (3%). Notably, 40.9% of respondents were from companies with over 200 employees, and 71.9% had children. Respondents'

positions varied across occupational roles. To assess non-response bias, we analyzed relationships between variables, including superior-subordinate communication, trust, gender, age, job position, marital status, having children, company size, and job nature, against seven demographic variables. *T*-tests confirmed no statistically significant differences at the 99% confidence interval, suggesting non-response bias was not a concern.

Measures. The superior-subordinate relationship is critical to overall project execution in technology-intensive business sector settings. Therefore, we focused on the following dimensions: (i) Superior-subordinate trust (Table A2): assessed through (a) communication openness—whether employees feel free to discuss issues with superiors; (b) perceived support—whether staff members believe superiors will assist during challenging times; and (c) trust evaluation—the degree of trust employees and colleagues have for superiors (Addison & Teixeira 2020; Hancock et al. 2023; Legood et al. 2021). (ii) Transformational leadership style (Table A3): evaluated through (a) prioritization of collective interests—whether superiors prioritize team goals; (b) innovation mindset—whether superiors are open-minded and encourage innovation; and (c) work enthusiasm—whether superiors demonstrate high dedication to their work (Messmann et al. 2022; Shafi et al. 2020). (iii) Self-efficacy (Table A4): measured by (a) problem-solving confidence, (b) challenge management, and (c) emergency handling capabilities (Christensen-Salem et al. 2021; Na-Nan et al. 2021). (iv) Superior-subordinate communication (Table A5): measured by (a) communication frequency and timeliness, (b) decision explanation clarity, and (c) communication channel effectiveness (McLarty et al. 2021; Miao et al. 2020). To control individual factors affecting communication ability, we included three demographic variables: age, marital status, and presence of children, coded as dummy variables based on common research practices.

Common method bias

Reliability and validity analysis. Given the use of scales to measure primary variables, verifying data quality is essential for meaningful analysis. We assessed internal consistency using Cronbach's alpha, where reliability coefficients above 0.6 are considered marginally acceptable for research purposes. Scores

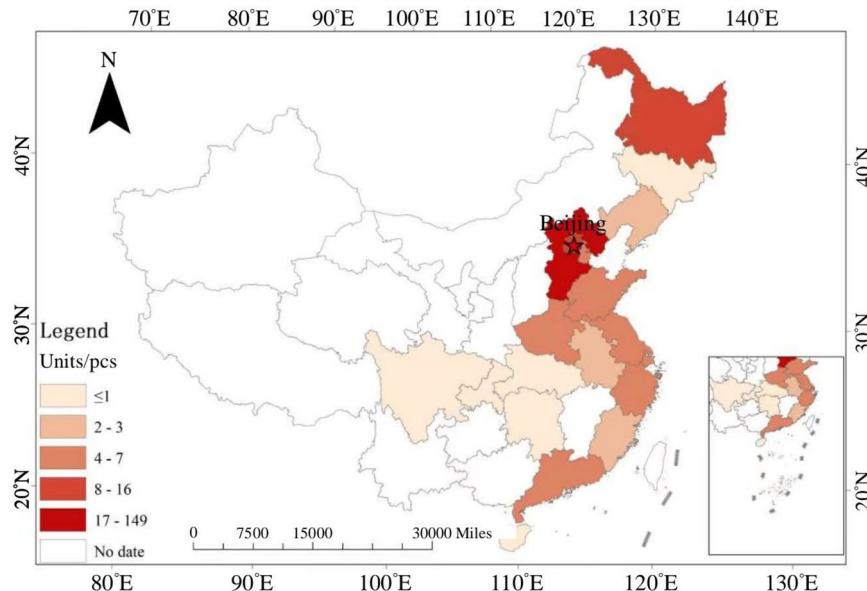


Fig. 2 Map of the study area utilized in this research.

between 0.6 and 0.7 are acceptable; 0.7 and 0.8 indicate satisfactory reliability; 0.8 and 0.9 show high reliability; and scores of 0.9 and 1 denote excellent reliability (Miller & Simmering 2020; Sen 2022). The measurement instrument was pretested based on existing literature and included multi-item scales for theoretical constructs (Liu et al. 2020; Pan et al. 2023). The Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity confirmed (Table 1) the adequacy of the data for factor analysis (KMO = 0.861, Bartlett's $\chi^2 = 1230.777$, $p < 0.0001$). All scales in this study displayed reliability coefficients between 0.9 and 1, indicating high internal consistency and reliability. The model fit indices ($\chi^2 = 3.664$, root mean square error of approximation (RMSEA) = 0.1, comparative fit index (CFI) ≥ 0.8) also indicated a satisfactory model fit (Table A6). Consequently, the confirmatory factor analysis model of trust and communication is well-suited to this task.

Convergent validity and composite reliability. Following model confirmation, we evaluated convergent validity (AVE) and composite reliability (CR) for each construct using standardized factor loadings (Fig. 3). An AVE of ≥ 0.5 and CR of ≥ 0.7 indicate reasonable convergent validity and composite reliability (Alhambra-

Borrás et al. 2021). All dimensions met these thresholds, indicating robust reliability and validity.

Normality test of variables. Finally, descriptive statistics and normality tests (skewness and kurtosis) were conducted. Based on the descriptive statistics show mean variable scores between 3 and 5, indicating that respondents' cognitive and behavioral responses regarding superior-subordinate relationships were above average (Fig. 4). According to acceptable criteria (Papadopoulos & Parmeter 2021), skewness values within ± 3 and kurtosis within ± 8 confirm approximate normal distribution, which was achieved for all variables in this study.

Mediation analysis. The structural equation model (SEM) was tested with AMOS, incorporating latent variables and chain mediation effect coding as inputs (Pavlov et al. 2020). To achieve reliable measurements, total scores were used to represent latent structures, simplifying the model, reducing identification issues, and improving the variable-to-sample size ratio (Velasquez & Zhang 2020; Wang et al. 2021). To examine the mediating effects within the superior-subordinate relationship model (H2b, H3b, and H4), we employed SEM, following others (Pavlov et al. 2020). This approach, preferred over the old method, offers (a) the ability to test both full and partial mediation, (b) reduced Type I error probability, and (c) increased statistical power (Papadopoulos & Parmeter 2021). SEM provides a holistic framework to test hypothesized relationships while considering the simultaneous effects of all variables.

Statistical analysis was performed using SPSS Version 21 (IBM Corp., Armonk, NY, USA) to perform descriptive statistics and correlation coefficients.

Table 1 The Kaiser-Meyer-Olkin measure and Bartlett's sphericity test.

KMO measure of sampling adequacy	0.861
Bartlett's test of sphericity	1230.777
Approximate Chi-Square	
Degrees of freedom	6
Significance	0.000

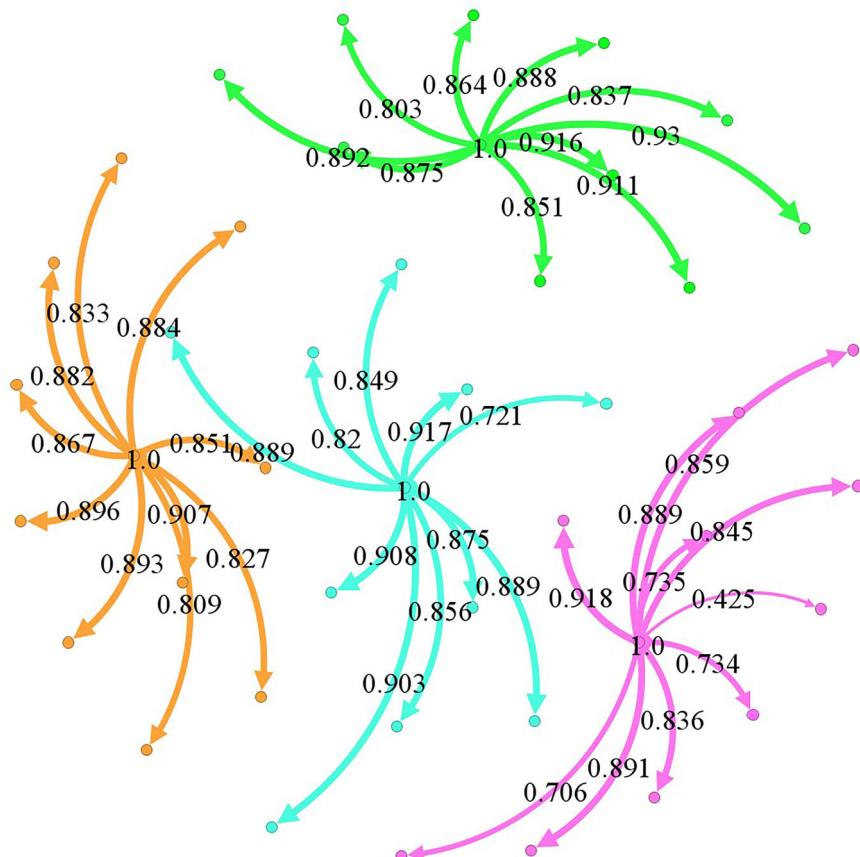


Fig. 3 Network diagram of standardized factor loadings across dimensions of superior-subordinate relationships.

Results

Correlation analysis among variables. This study explored the structural model of hypotheses through Pearson correlation analysis, assessing the correlations between each variable (Table 2). The analysis indicated significant positive correlations between all variables, each within the 99% confidence interval. The correlation coefficients were all greater than 0.850***, suggesting a robust positive relationship between the variables under consideration. Additionally, control variables were analyzed. We observed that the mediating variables significantly mediate the relationship between independent and dependent variables, regardless of control variables (age, marital status, and presence of children). This finding suggests that the control variables do not significantly alter the overall chain mediation effect model.

Robustness test. Prior to incorporating the chain mediation model, results (Table 3) from the path hypothesis tests show that factors influencing communication between superiors and subordinates (H1, H2a, and H3a) are significantly affected by superior-subordinate trust ($\beta = 0.681, p < 0.001$), transformational leadership ($\beta = 0.152, p < 0.05$), and self-efficacy ($\beta = 0.167, p < 0.05$). Each of these paths was statistically significant and meaningful. Additionally, superior-subordinate trust significantly influenced transformational leadership ($\beta = 0.905, p < 0.001$) and self-efficacy ($\beta = 0.215, p < 0.05$), with transformational leadership also significantly predicting self-efficacy ($\beta = 0.713, p < 0.001$). All paths aligned with the hypothesized relationships and were statistically significant.

Upon incorporating the chain mediation model, results (Table 4) showed consistent standardized coefficients across all paths, which remained highly significant ($p \leq 0.001$), indicating the robustness of the model. The consistent findings across both model scenarios underscore the model's robustness.

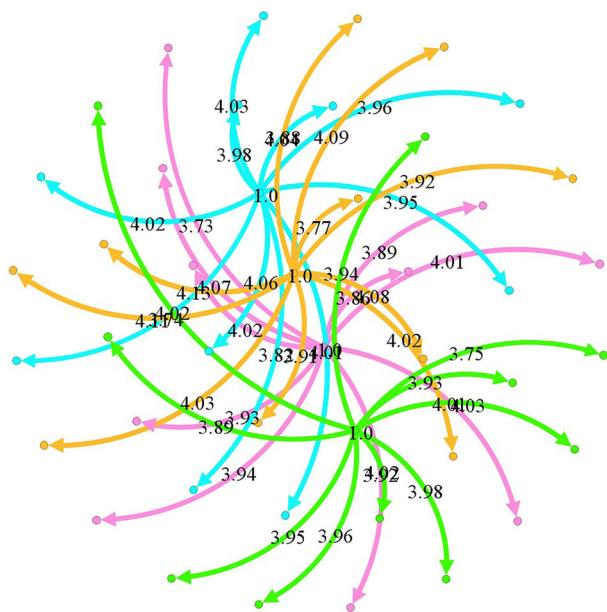


Fig. 4 Mean network diagram of items for each dimension within superior-subordinate relationships.

Hypothesis testing. The fit indices for the hypothetical model ($\chi^2 = 3.664$, CFI = 0.846, root mean square residual = 0.05, RMSEA = 0.10) indicated a satisfactory fit with the data (Table A6). There were three relationships tested using *T*-tests. Among them were superior-subordinate trust, communication, self-efficacy, and transformational leadership (H1, 2a, 3a). All three were statistically significant at the 0.01 level (Table 5). The indirect effects, as proposed in H2b and H4, as well as the total effect, were statistically significant at or above the 95% confidence level. Each hypothesized relationship aligned with the expected direction. Specifically, superior-subordinate trust has a statistically significant impact on communication between superiors and subordinates ($\beta = 0.92$, $t = 35.46$, $p < 0.001$), transformational leadership ($\beta = 0.87$, $t = 26.27$, $p < 0.001$), and self-efficacy ($\beta = 0.85$, $t = 24.63$, $p < 0.001$). It was interesting to see how the interaction between transformational leadership and self-efficacy in the context of superior-subordinate trust had important mediating effects: transformational leadership ($\beta = 0.56$, $t = 12.75$, $p < 0.001$) and self-efficacy ($\beta = 0.62$, $t = 14.19$, $p < 0.001$); and transformational leadership and self-efficacy together ($\beta = 0.50$, $t = 10.89$, $p < 0.001$). Control variables,

Table 2 Results of Pearson correlation analysis across various dimensions.

Dimension	Trust	Communication	Self-efficacy	Transformational leadership
Trust	1.000			
Communication	0.918***	1.000		
Self-efficacy	0.850***	0.880***	1.000	
Transformational leadership	0.865***	0.899***	0.888***	1.000

*** significant at $p < 0.001$ (two-tailed).

Table 3 Hypothesis testing results of path relationships in the SEM model for factors influencing superior-subordinate communication.

Path relationships			Estimate	S.E.	C.R.	P
Transformational leadership	←	Trust between superiors and subordinates	0.905	0.06	12.67	***
Self-efficacy	←	Trust between superiors and subordinates	0.215	0.077	2.534	0.011
Self-efficacy	←	Transformational leadership	0.713	0.108	7.104	***
Communication between superiors and subordinates	←	Trust between superiors and subordinates	0.681	0.06	9.806	***
Communication between superiors and subordinates	←	Transformational leadership	0.152	0.076	2.038	0.042
Communication between superiors and subordinates	←	Self-efficacy	0.167	0.056	2.816	0.005

*** significant at $p < 0.001$.

Table 4 Correlation between theoretical constructs.

Factors	Mean	S.D.	Trust	Communication	Self-efficacy	Transformational leadership
Trust	3.938	1.108	1.00***			
Communication	3.947	1.050	0.92 ***	1.00***		
Self-efficacy	3.994	0.993	0.85***	0.88***	1.00***	
Transformational leadership	3.961	0.988	0.87***	0.90***	0.89***	1.00***

*** significant at $p < 0.001$.**Table 5 Indirect (Ind) and direct (Dir) effects.**

Exogenous variables	Exogenous variables											
	Communication		Transformational leadership		Self-efficacy		Communication		Communication		Communication	
	Ind	Dir	Ind	Dir	Ind	Dir	Ind	Dir	Ind	Dir	Ind	Dir
Trust	0.00	0.92 (35.46***)	0.00	0.87 (26.27***)	0.00	0.85 (24.63***)	0.56 (12.75***)	0.56 (12.75***)	0.62 (14.19***)	0.62 (14.19***)	0.50 (10.89***)	0.50 (10.89***)
Transformational leadership							0.42 (9.44***)	0.42 (9.44***)			0.30 (5.69***)	0.30 (5.69***)
Self-efficacy									0.36 (8.25***)	0.36 (8.25***)	0.19 (3.88***)	0.19 (3.88***)
R-squared	0.844		0.748		0.722		0.887		0.879		0.894	
Adjusted R-squared	0.843		0.746		0.721		0.886		0.878		0.893	
F-statistic	1257.07***		689.87***		606.48***		910.66***		843.45***		648.98***	

*** t-Values significant at $p < 0.001$.**Table 6 Bootstrap analysis and effect size assessment in significance testing of mediation effects.**

Parameter	Estimate	Lower	Upper	P	Effect size proportion
Trust between superiors and subordinates → Transformational leadership style → Self-efficacy → Communication between superiors and subordinates	0.097	0.023	0.204	0.03	0.112
Trust between superiors and subordinates → Transformational leadership style → Communication between superiors and subordinates	0.032	0.003	0.092	0.061	0.037
Trust between superiors and subordinates → Self-efficacy → Communication between superiors and subordinates	0.123	-0.016	0.3	0.154	0.143
Total effect	0.862	0.773	0.939	0.001	

including age, marital status, and the presence of children, were significant.

Mediation analysis. The paths from superior-subordinate trust to self-efficacy, transformational leadership, and communication were statistically significant. The paths from self-efficacy and transformational leadership to communication were also significant, suggesting that self-efficacy and transformational leadership indeed mediate the trust-communication relationship. Table 6 confirms the mediating effects of transformational leadership and self-efficacy. It demonstrated the three mediating paths between superior-subordinate trust and communication: Indirect Effect 1: “Superior-subordinate trust → transformational leadership → self-efficacy → communication”, with an effect of 0.097 and a Bootstrap 95% CI of [0.023, 0.204] (excluding 0), indicating a significant chain mediation effect of transformational leadership and self-efficacy. (b) Indirect Effect 2: “Superior-subordinate trust → transformational leadership → communication”, with an effect of 0.032 and a Bootstrap 90% CI of [0.003, 0.092] (excluding 0), indicating that transformational leadership significantly mediates the trust-communication relationship. (c) Indirect Effect 3: “Superior-subordinate trust → self-efficacy → communication”, with an effect of 0.123 and a CI of [-0.016, 0.3] (including 0), suggesting that self-efficacy’s mediating role

between trust and communication was not statistically significant ($p > 0.001$). The total effect value was 0.862, with a 95% CI of [0.773, 0.939], confirming a significant total effect. The calculated proportions of the mediation effects indicate that transformational leadership and self-efficacy accounted for 11.2% of the chain mediation effect, while transformational leadership alone accounted for 3.7%. This result suggests that while transformational leadership fully mediated the relationship between superior-subordinate trust and communication, self-efficacy’s mediating role was less significant without transformational leadership’s influence.

The SEM demonstrated the relationship between transformational leadership, self-efficacy, trust, and communication (Fig. 5). Transformational leadership strongly influences self-efficacy (0.713) and trust (0.905), indicating that leaders who demonstrate transformational qualities foster higher self-efficacy and trust among their followers. Leadership style also has a weaker yet positive direct effect on communication (0.152), suggesting that transformational leadership indirectly supports effective communication through other variables. Self-efficacy is shown to be a moderate predictor of both trust (0.215) and communication (0.167), implying that individuals with higher self-efficacy levels tend to exhibit greater trust and communicate more successfully. However, trust has a more substantial direct effect on communication (0.681), highlighting its role as a crucial intermediary

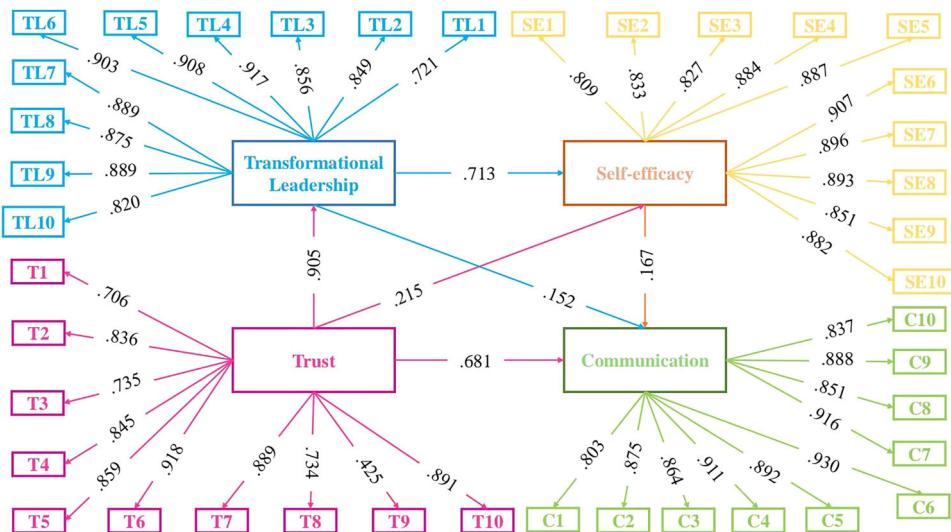


Fig. 5 The structural equation model illustrates relationships between variables and the overall structure.

that facilitates open and effective communication channels. The model suggested a chain of influences where transformational leadership enhances self-efficacy and trust, with trust acting as a strong predictor of communication, thereby underscoring the interconnectedness of these variables in promoting effective organizational dynamics.

Discussion

This study identifies essential pathways through which superior-subordinate trust influences communication within organizational settings. Interestingly, control variables—such as age, marital status, and parental responsibilities—did not significantly alter the model's overall performance, suggesting they have limited influence on the primary relationships examined. Regarding age, prior research has shown that age similarity among employees can enhance job satisfaction and engagement levels (Avery et al. 2007). Additionally, internal motivation often strengthens with age, while reliance on extrinsic motivators may decline, reflecting age-related shifts in employees' perceptions of work (Shi et al. 2023b). As for marital status and family responsibilities, studies indicate that work-life balance does not significantly vary by marital or parental status (Denson & Szelényi 2022). However, the quality of marital relationships can mediate work-family conflict, with positive spillovers from family life potentially boosting work performance (Fan et al. 2021). For employees with children, larger family sizes have been associated with lower life satisfaction, which may indirectly influence work-related stress and performance (Shi et al. 2023a). While these factors contribute to the broader life context and individual stress levels, they do not directly impact the mediation pathways explored in this model. Instead, they appear to affect the independent variables—trust, self-efficacy, and transformational leadership—rather than the mediating relationships themselves (Legood et al. 2021).

Trust is a cornerstone of organizational dynamics, serving as a vital bond between individuals—one that is challenging to restore once damaged (Kähkönen et al. 2021). In this study, H1, H2a, and H3a revealed that trust between superiors and subordinates significantly enhances communication by reducing psychological distance and fostering mutual understanding (Hancock et al. 2023). This trust subsequently strengthens employee self-efficacy and supports transformational leadership behaviors (Le & Nguyen 2023). Maintaining trust is crucial, as our findings show a clear link: stronger trust leads to smoother, more effective

communication, which, in turn, reinforces the dynamic of trust itself (Sweijen et al. 2023). Self-efficacy also partially mediates the trust–communication relationship, with a notable direct impact on communication quality (Tian & Guo 2022). Employees with high self-efficacy tend to adapt well to workplace demands, which bolsters their confidence in interpersonal interactions (Christensen-Salem et al. 2021). High self-efficacy not only enhances work performance but also elevates communication quality, as these employees engage more frequently and effectively with their superiors (Ilyas et al. 2020). Similarly, managers with high self-efficacy are more likely to adopt a positive communication style, reducing misunderstandings and enhancing clarity (Zainab et al. 2022).

Transformational leadership, in particular, facilitates the relationship between trust and communication by inspiring positive changes and fostering innovation within technology-intensive business industries (Gao et al. 2020). Increased employee engagement and job satisfaction closely correlate with this leadership style, which enhances communication through shared organizational goals (Chen et al. 2022; Khan et al. 2020). Transformational leaders effectively communicate the organization's vision, creating alignment and cohesion among employees (Lim & Moon 2020; Siangchokkyoo et al. 2020). Consequently, transformational leadership strengthens superior-subordinate communication by cultivating a more connected and cohesive organizational culture (Vila-Vázquez et al. 2024). The findings also indicate that while self-efficacy plays a significant role in direct communication between superiors and subordinates, it is not a primary mediating factor in the trust–communication relationship. Considering the model's robustness and sample size, we interpret this to mean that transformational leadership is a more powerful mediator. This may be because transformational leaders inspire such charisma that profoundly shapes the trust–communication dynamic, surpassing the influence of self-efficacy (Yang et al. 2020; Yuan et al. 2022).

The mediation analysis of the pathway from superior-subordinate trust to transformational leadership, self-efficacy, and communication (H4) confirms the statistical significance of these relationships. Trust in leadership empowers leaders to embrace dynamic styles, motivating employees to work towards organizational goals and fostering a sense of satisfaction that gradually builds self-efficacy (Le & Nguyen 2023). As transformational leaders engage employees around shared goals, employees gain confidence and satisfaction (Yin et al. 2020). This

promotes closer and more effective communication with their superiors. This dynamic ultimately strengthens the superior-subordinate relationship (Gao et al. 2020). Therefore, this study demonstrates that transformational leadership and self-efficacy act as full and partial mediators, respectively, between trust and communication in superior-subordinate relationships. The proposed hypotheses are largely supported, offering valuable insights for technology-intensive business industries striving to enhance communication and trust through leadership development and employee empowerment initiatives. Research on transformational leadership and self-efficacy provides a solid framework for organizations looking to innovate and adapt in rapidly changing environments (Wang et al. 2025), underscoring trust as a foundational element of organizational success.

This study was strategically designed to anchor our data collection on the principles of general management and psychology. These fields offer a robust foundation of theories developed through decades of rigorous research. In contrast, technology-intensive industries often lack maturity and consensus. Practical challenges also shape this decision. In the tech sector, confidentiality agreements often protect critical data, making it difficult to obtain transparent insights. Management and psychology frameworks, however, are more accessible through surveys, experiments, and established metrics, allowing researchers to gather diverse datasets efficiently. Additionally, management and psychology concepts have broader applicability, providing insights that resonate across sectors, whereas tech-specific data tends to be niche. By prioritizing universality, this study aims to empower a wide range of organizations. A key innovation is the integration of these frameworks into tech environments. Applying organizational behavior research to tackle challenges in AI development or quantum computing validates and evolves existing theories. This creates strategies for tech leaders to address burnout, communication gaps, and innovation bottlenecks (Ai et al. 2025; Deng et al. 2025). This approach respects the uniqueness of the tech industry while equipping enterprises with evidence-based tools from interdisciplinary research. By leveraging management insights into motivation and leadership, tech companies can cultivate flexible and sustainable cultures, turning theoretical rigor into a competitive advantage.

Conclusions

This study sought to deepen both theoretical and empirical insights into superior-subordinate relationships by examining the influence of transformational leadership and self-efficacy on trust and communication. Our findings empirically support hypothesized relationships, reinforcing the core theoretical proposition: transformational leadership and self-efficacy are strategic pathways for organizations to foster stronger superior-subordinate connections. On a practical level, our results emphasize that trust between superiors and subordinates has a direct, positive impact on communication dynamics. Furthermore, transformational leadership and self-efficacy are crucial mediators, shaping trust and communication. This highlights that while adopting a transformational leadership style is crucial, it is not enough to create organizational advantages. Successful implementation requires mutual trust and awareness of employees' self-efficacy. Thus, managers can cultivate a strategic vision that guides informed decision-making and helps them navigate organizational challenges effectively. Meanwhile, employees are encouraged to build trust in their leaders and foster self-confidence. Acknowledging the importance of these elements is vital for companies to move towards learning organizations. Addressing issues in superior-subordinate relationships requires individual initiative. Employees can make efforts to better understand their superiors, actively building mutual trust and reducing information gaps. Leaders can focus on improving

communication and developing soft skills. As the trend towards learning organizations continues, these efforts will support ongoing organizational development and growth. In the fast-changing technology industries, managers need to adapt communication strategies to evolving challenges. Those who adjusted swiftly ensured teams' access and shared critical information efficiently, boosting competitiveness. To maintain communication effectiveness, organizations implement ongoing assessment systems. Regular satisfaction surveys and evaluations help identify communication gaps, leading to targeted improvements. This proactive strategy ensures communication remains the key to innovation and long-term success.

Practical applications. Despite their widespread application, self-efficacy and transformational leadership theories for workplace communication remain underexplored in technology-intensive business sectors. This study addresses that gap by illustrating how self-efficacy and transformational leadership theories relate to organizational communication. Transformational leadership enhances communication by increasing self-efficacy and trust. Organizations may focus on developing these skills among managers through training and experience. Strengthening these competencies improves job satisfaction and fosters open communication. Enhancing self-efficacy bolsters trust and a willingness to dialog. Companies can provide training and career development opportunities to support growth and improve team communication. Trust is essential for organizational communication, and businesses may foster a high-trust environment. Transparent practices and constructive feedback lead to increased motivation and collaboration, which contribute to overall performance.

Limitations of the study. This study has certain limitations that suggest valuable directions for future research. While the online questionnaire method was efficient, it may have limited the authenticity and contextual depth of the responses. Additionally, although the sample was supplemented by 2000 bootstrap resamples, the overall size remains relatively small. Future research could aim to include larger, more diverse samples and consider incorporating offline data collection methods to enrich the authenticity of the data. This study also did not address other industry-specific factors, leaving room for future studies to categorize other industries and perform targeted analyses. Another limitation concerns the scope of control variables; only seven demographic variables were considered, which may not fully capture all relevant factors. Expanding the range of control variables in future research could allow for a more detailed and comprehensive analysis. Furthermore, while AMOS was employed to construct the chain mediation model, our findings indicate that self-efficacy plays only a partial mediating role. Future studies could explore the moderating effect of self-efficacy on superior-subordinate relationships, providing a more multi-dimensional understanding of their influence. Models that rely solely on general management and psychology constructs may not fully capture the key factors shaping technology-intensive businesses. For instance, critical elements such as rapid technological advancements and the driving forces behind innovation—both of which significantly impact technology companies—may be overlooked. To address this gap, future research can build upon existing models by incorporating industry-specific constructs, further enriching and refining their applicability. Additionally, fostering stronger collaborations with technology companies can provide access to more relevant data, enhancing research precision and real-world practicality. Despite these limitations, this study offers compelling evidence that individual attributes, particularly transformational leadership style and self-

efficacy, play pivotal roles in fostering shared values and maintaining positive relationships between superiors and subordinates.

Data availability

All data generated or analyzed during this study are included in this published article.

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Author contributions

Conceptualization: ZZ, MA; Methodology: ML, ZZ, FW, MA; Software: ML, ZZ, FW, MA; Validation: ML, ZZ, FW, MA; Formal analysis: ML, ZZ, FW, MA; Investigation: ML, ZZ, FW, MA; Resources: ML, ZZ, FW, MA; Data curation: ML, ZZ, FW, MA; Writing—original draft preparation: ML, ZZ, FW, MA; Writing—review and editing: ML, ZZ, FW, MA; Visualization: ML, ZZ, MA; Supervision: ML, FW, MA; Project administration: ML, FW, MA; Funding acquisition: ML, FW, MA; All authors have read and agreed to the published version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethics approval

This study was approved by the Institutional Review Board (or Ethics Committee) of Heilongjiang University (Approval No. HLJU-20221204) on December 13, 2022. All procedures were conducted in accordance with institutional and national research committee standards and the Declaration of Helsinki (1964) and its later amendments. The approval covers participant recruitment, data collection, data management, and dissemination of anonymized findings.

Informed consent

Written informed consent was obtained from all participants between February and June 2023. Consent was obtained after participants were fully informed about the study's purpose, procedures, scope of data use, potential risks and benefits, and their right to withdraw at any time without penalty. All participants consented to both participation and the publication of anonymized data. No identifying information is included in this manuscript.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used Wordtune and Grammarly in order to fix grammatical errors and enhance understanding of context and meaning. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Additional information

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