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How Does Transformational Leadership Promote Innovation in Construction? The Mediating Role of Innovation Climate and the Multilevel Moderation Role of Project Requirements

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Abstract: Innovation plays a critical role in the sustainable development of the construction industry. This research aims at examining transformational leadership's role in shaping employees' innovative behavior by analyzing the mediating effect of innovation climate and the cross-level moderating effect of innovativeness as a project requirement. To achieve this aim, a questionnaire survey was conducted with 300 construction industry professionals in China and 251 valid replies were received. Data collected by the questionnaire were analyzed using the method of hierarchical linear modeling (HLM). The results showed that transformational leaders could nurture a mutual climate for innovation to motivate employees' innovative behaviors. In addition, innovativeness as a project requirement at the project level strengthens the indirect link amongst transformational leadership and innovative behavior via the innovation climate. Therefore, in the presence of higher innovativeness as a project requirement, transformational leadership is more prone to exert a positive influence upon an individual's innovative behavior via the perceived innovation climate. The research findings improve understanding of the roles of leadership and innovation climate in affecting individual behavioral outcomes, and could help project managers and leaders encourage innovative ideas within project organizations.

Keywords: construction innovation; innovative behavior; transformational leadership; innovation climate; innovativeness as a project requirement; hierarchical linear modeling

1. Introduction

Innovation has been viewed as one of the key factors contributing to the competitiveness of construction enterprises [1]. Innovation has a context-sensitive nature [2], i.e., the modes of innovation within the construction industry differ from those within the manufacturing and service industries. Scholars of innovation have argued that the way in which innovation is implemented and what drives innovation are heavily related to industry-specific features [3]. Prior research has recognized the construction industry's diverse and project-based characteristics [4], highlighting the new, complex issues on construction sites and calling for innovative solutions [5]. Thus, innovation is crucial to the successful implementation of construction projects [6]. Nonetheless, the construction industry is considered a non-innovative and conservative industry [7], because there are many barriers to innovation in construction [8]. To address these problems, previous studies regarding construction

innovation primarily focused on the organizational impacts at the organizational level [9,10] and the process model at the project level [4,8] while rarely explored or focused on innovation at the individual level.

Based on the viewpoint of the source of innovation, several innovation drivers, such as "innovation networks" [11], "innovation-stimulating regulations" [12], "innovation champions" [13], and "owners" [14], have been explored at different levels in construction. Many scholars have stated that "market demand pulls innovation" and "technology pushes innovation" [15]. Nevertheless, how these drivers are used to facilitate construction innovation, and at which levels these drivers operate, are two central questions that remain unanswered. Hence, the present study utilized the contingency theory of leadership [16] to improve understanding of the relations among leaders, followers, and the contexts of construction innovation. Individuals or followers may be influenced by the characteristics and behaviors of their leaders. The role of the leader or manager has been identified as a motivator of individuals' creativity in previous studies [17]. Also, they may be affected by the organizational context, including the organizational size, task complexity, and environmental uncertainty. The different organizational context could provide important different implications on the effectiveness of leadership [18]. In this study, innovative behavior, which is associated with the antecedents (i.e., transformational leadership style and innovation climate) and project context (i.e., innovativeness as a project requirement), is considered the dependent variable in the conceptual model, based on the notion of leadership contingency and innovation impetus.

The purpose of this research is to gain a deeper understanding of the effect of transformational leadership on followers' innovative behaviors and uncover the mechanism through which the effect would occur and the boundary condition under which the relationships would be enhanced. There are certain theoretical and practical contributions of this research. First, this research indicates that transformational leadership and innovation climate within a project organization are different antecedents of project members' innovative behaviors. While the literature on construction innovation has focused more on the importance of leadership in construction projects [8,19,20], little is known about how leaders encourage employees to engage in innovative attitudes and behaviors. Therefore, according to leadership contingency theory and social cognitive theory, studying the role of innovation climate in the correlation among transformational leadership and innovative behavior is both theoretically and practically important. Second, most prior studies have adopted a single-level approach of analyzing the construction innovation [21]. There exist multilevel associations between leadership and creativity or innovation [22], e.g., transformational leadership at individual level predicts innovation in teams [23], and scholars have suggested and focused that how transformational leadership affects employees' creative outcomes through team-level processes [24]. The present research demonstrates the multilevel mechanism in construction innovation and unveils the cross-level moderating effects of project requirements as the boundary conditions for strengthening the effect of leadership. The multilevel mechanisms that link transformational leadership and innovative behavior are tested to respond to the call for research to recognize influence mechanisms of transformational leadership, detailing the outcome and considering the different level of analysis [25]. Hence, this research offers a more integrative viewpoint of how project leaders or managers shape project members' innovative behaviors, building mutual visions, developing innovation climates, and proposing or emphasizing the innovativeness as a project requirement.

The remainder of this paper is structured into five sections. Section 2 presents the theoretical foundation, review of the literature, and development of hypotheses. Section 3 deals with the identification of the measures, sampling design, and data collection. It also discusses the methodology adopted in this study and explains specifically the procedure of hierarchal linear modeling (HLM) and the moderated mediation analysis. Section 4 discusses the measurement assessment, including the reliability and validity of the analysis, as well as hypothesis testing using hierarchical linear modeling (HLM). Section 5 summarizes and discusses the findings, as well as their implications. Section 6 presents the conclusions of the study.

2. Theory and Hypotheses

2.1. Theoretical Foundation

Contingency theories of leadership explain leadership effectiveness in terms of different situations or the effect of leadership behavior on outcomes as varying across different conditions [16]. The multiple-linkage model states that the interacting effects of a manager's behavior and situational variables determine the performances of individuals or work units [26]. The effectiveness of performance is contingence on two factors, namely the motivational pattern from a leader (e.g., transformational leadership [27]) and contextual factors [28]. Leaders give their subordinates a sense of what is important in the organizational reality or point out directions to show employees the purpose of their work, thereby stimulating their wish to achieve the defined goals. Thus, the character and charisma of leaders influence the behavior of employees. Leaders could play a role in encouraging the productive of employees' creative outcomes [29], and leadership is also a key predictor of innovation [30]. Meanwhile, the link between leaders and subordinates would be transferred by the mediating variables, such as cooperation, commitment, and organizational support. Moreover, there are some contextual variables, such as the organizational culture, work requirements, and strategy. Therefore, leaders exert influence on their subordinates by various means.

Social cognitive theory is entrenched within the perception that human action is caused by the personal behavior of others and/or the external environment [31]. Organizational leaders not only manage or regulate their own styles or behaviors but also influence their followers' actions because the essence of organizational leadership is to direct the followers' actions toward the accomplishment of organizational or group goals [32]. The key component of human action is the personal own belief or cognition, which permits individuals to be proactive or regulators of their actions [33]. Thus, the followers' or individuals' beliefs and cognition are important to the exercise of the leaders' influence on individuals [34,35].

According to the multiple-linkage model of leadership contingency theory and social cognitive theory, individuals' cognition and organizational context or environment are critical to the impacts of leaders on followers. Prior empirical research in the context of construction innovation has tested the effects of leadership on fostering innovation climates [21]. To be precise, transformational leadership has been positively correlated to innovation climate and possesses the ability to motivate followers' intrinsic considerations for participation in innovation and creativity. Liu and Shi noted that an innovation climate reflected the individuals' cognition for the sense-making of the working environment [36] or the consistent cognitive experience of the innovation environment, which affects their innovative behaviors [37]. In addition, an important cause of behavior generation is the psychological environment as perceived by the individuals or followers [38].

On sources of innovation in construction, some industry professionals, having experience with innovative projects, have asserted that "problems are the mother of construction innovation" and that "owners' demands dictate innovation" [5]. These viewpoints highlight the value of demand-side factors within the innovation process. Demand-side factors, such as demand from owners, can greatly influence the construction innovation process and induce project participants to invest resources, technology, funds, etc., in innovative activity. Supply-side factors, such as technology, have also attracted attention regarding the construction innovation process. Moreover, it is hard to answer the question "which one comes first in developing construction innovation: owners' demands or problems?" Thus, the sources of construction innovation include not only demand-side factors but also supply-side factors.

Previous studies have provided insights into depicting the link between transformational leadership and employee innovation or creative behaviors [39,40], or transformational leadership and organizational climate [41,42]. There have been few empirical studies to integrate these factors and explore the multilevel mechanisms in the context of construction projects. Hence, this study draws on leadership contingency theory, social cognitive theory, and the extant construction innovation

literature to state that the perceived innovation climate and the orientations of project goals would affect how leaders influence individuals' behaviors in construction projects at different levels (including individual level and project level). The components of the mechanism in this study are transformational leadership, individual performances (i.e., innovative behavior), mediators (i.e., perceived innovation climate), and situational variables (i.e., innovativeness as a project requirement). Figure 1 illustrates the hypothesized conceptual model for this research.

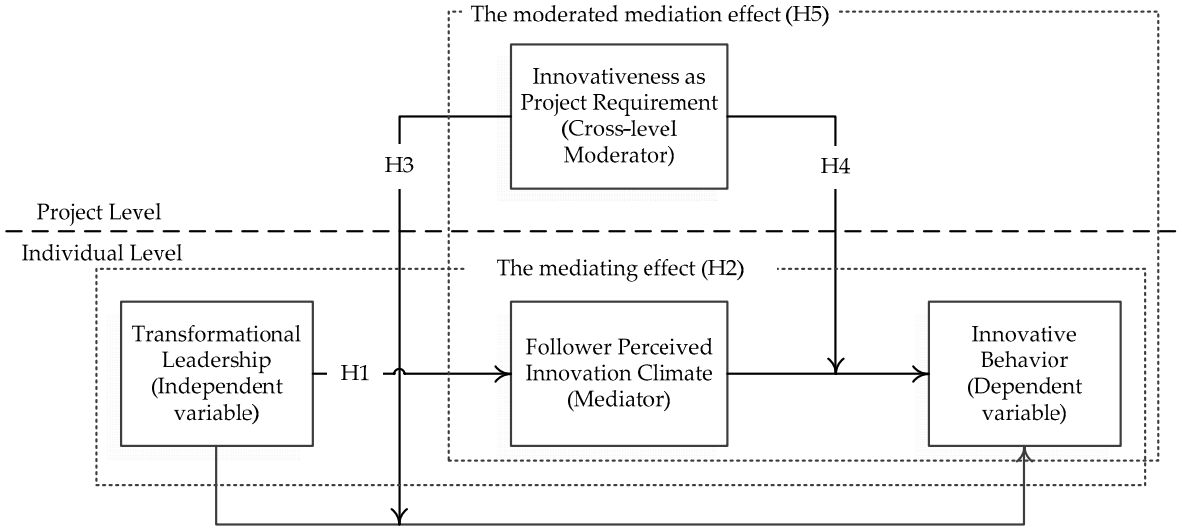

Figure 1. The hypothesized model.

2.2. Transformational Leadership and Innovation Climate in Projects

Many scholars, e.g., Nam and Tatum [13], Chan et al. [21], Ozorhon et al. [19,43], and Zheng et al. [44], agree that leadership is a key factor for facilitating innovation in construction. Leadership has a pivotal role in forming the spirit of a project [45]. Transformational leaders typically focus on meeting their followers' higher-order intrinsic needs [7], including charisma, vision stimulation, intellectual stimulation, and individualized consideration [46]. Transformational leadership of a team may form a deeper understanding and appreciation from all team members [47]. Leaders will influence the proactivity of team members, and foster their active engagement in developmental or creative activities [22]. Project managers can act as leaders to create a vision or motivate project members to achieve project goals (e.g., innovation) [8].

The climate for innovation at the organizational level or group level is defined as what the individual perceives to be the collective expectations of, cognition of, or support for innovation [8,48]. The innovation climate in project organizations has also been viewed as an important factor in construction innovation. The main component of innovation climate is the support for innovation, which is derived from an organization or other project members.

Previous research has found empirical evidence of transformational leadership's positive correlation with an organizational creative climate at the firm level [21]. The leadership could shape the supportive climate in a unit or organization [49]. Transformational Leaders would create a climate in which employees feel motivated when engaging in innovative thinking or activities [50]. There is also evidence from other contexts, for instance, a strong positive relationship amongst transformational leadership and organizational climate within non-profit organizations [51]. The climate represented the collective cognition and values, on whose formation leaders or managers had substantial impacts [52]. Schein [53] argued that the beliefs of leaders could be a part of the organizational climate. Jung [54] also claimed that leaders or managers play important roles in developing the climate. According to Jung [55], transformational leaders help to build the climate by questioning employees' thinking, and establishing the mutual vision. Although the above studies focused on the

relationship amongst transformational leadership and climate, this relationship has been examined only at the firm level. Leaders can offer opportunities for team members to develop the need for creativity or innovation which then enable members to be more effectively produce creative outcomes (e.g., creativity, or innovative behavior) [56]. Thus, it is worthwhile to examine the relationship amongst transformational leadership and climate at the subunit level [57]. To this end, this study proposes the existence of a positive relationship amongst transformational leadership and innovation climate in construction project settings.

Hypothesis 1. *Transformational leadership is positively related to innovation climate in construction projects.*

2.3. The Mediating Role of Innovation Climate

Behavioral science scholars have strong interests in the link amongst different leadership styles and employees' innovation outcomes (e.g., creativity [58]). Also, testing the relationship amongst transformational leadership and employees' innovative behaviors has received substantial attention from scholars of innovative behavior. For instance, Pieterse et al. [59] provided empirical evidence for such a relationship. Moreover, an innovation climate could be developed and established by transformational leaders who encourage people to perform toward creative outcomes [55]. A supportive climate could be served as a key mediator for innovation [60]. Scholars have analyzed the indirect impact of innovation climate upon transformational leadership and innovative behavior but there have been mixed results. For instance, Kang et al. [61] found that the innovative climate of a firm can mediate the relationship amongst the transformational leadership of the CEO of the firm and the innovative behaviors of the managers of the firm. Wang et al. [62] and Jaiswal and Dhar [57] also found that the mediating effect of an innovation climate upon the relation among transformational leadership and employees' creative outcomes is significant. Chen et al. [50] and Dong et al. [22] suggested that innovation climate may help translate the positive effect of transformational leadership to creative outcomes. Liu investigated the role of innovation climate on the relationships between leadership and innovation in construction [28]. However, Gumusluoglu and Ilsev discovered that internal support for innovation (i.e., innovation-supporting climate) had an insignificant effect on transformational leadership and organizational innovation in Turkish firms [63] but had a significant mediating effect in Chinese firms [64]. Scott and Bruce [48] emphasized that the employees' perceptions of the climate could mediate the influence of leadership on employees' innovative performances. Hence, this study proposes that project members' perceptions of the innovative climate mediate the relation amongst transformational leadership and innovative behaviors.

Hypothesis 2. *Transformational leadership has a positive indirect effect on innovative behavior through innovation climate in construction projects.*

2.4. The Moderating Effect of Innovativeness as a Project Requirement

According to goal-setting theory [65], most human behavior is guided by goals and could transfer the demand to motivate and stimulate individual efforts toward the goals. An innovation climate could represent the internal perceptions and motives of the employees, while the goal indicates the external pattern of behavioral motivation. Moreover, the goal-setting theory advocates that a difficult or complex goal could enhance task performance [66]. A project requirement for innovation is a contextual factor that could influence the potential outcomes, such as the employees' innovative behavior [67]. The innovativeness as a project requirement could be viewed as part of project goals. From a goal-setting perspective, innovativeness as a project requirement could impact employees' perceptions and internal motivations. Following a project goal for innovation, project members who perceive innovativeness as part of the organizational values, beliefs, or vision, and combined these with the impact of transformational leadership, are more likely to believe that generating creative

ideas and exhibiting innovative behavior would benefit the project. Transformational leadership is particularly likely to try advanced technology and practice, and transformational leadership can lead employees or members to take the changing environment as the opportunity for innovation [68].

From a social–political perspective, a project requirement for innovativeness indicates an external need for and expectation of innovation, which call for more ideas and innovative behaviors in a project environment. Scholars have suggested that employees may be likely to perform change-initiated behaviors when the organization, job position, or others provide the relevant support [69]. Thus, when the innovativeness is taken as part of project requirements, project members would feel that the innovative requirement is more favorable for the expression of their creative ideas, while transformational leaders establish mutual vision and encourage new approaches. They would also feel more confident about exhibiting innovative behaviors when a helpful climate for innovation exists. Thus, this study proposes the following hypotheses:

Hypothesis 3. *Innovativeness as a project requirement moderates the positive relationship between transformational leadership and innovative behavior such that this relationship is stronger in the presence of higher innovativeness as a project requirement.*

Hypothesis 4. *The positive effect of innovative climate on innovative behavior is moderated by innovativeness as a project requirement such that this positive effect is strong in the presence of higher innovativeness as a project requirement.*

2.5. An Integrative Moderated Mediation Model

As indicated in Section 2, this study has put forward the idea that transformational leaders are more likely to develop an innovation climate (Hypothesis 1). In addition, this study also argues that transformational leadership could have a positive impact upon individuals' innovative behaviors, based upon the perceived innovation climate in construction projects (Hypothesis 2). It is also hypothesized that innovativeness as a project requirement strengthens the positive link between individuals' perceptions of the innovation climate and their innovative behaviors (Hypothesis 4). Essentially, the combination of Hypotheses 1, 2, and 4 represents a moderated mediation model describing the indirect influence of transformational leadership upon innovative behavior. Hence, because of the positive moderating effect of innovativeness as a project requirement on the relationship amongst innovation climate and innovative behavior, innovativeness as a project requirement also possesses the potential to enhance the indirect impact of transformational leadership upon innovative behavior via the innovation climate. Therefore, this study hypothesizes the moderated mediation model as follows:

Hypothesis 5. *The positive indirect effect of transformational leadership on innovative behavior via innovation climate is moderated by innovativeness as a project requirement such that this positive indirect effect is stronger in the presence of higher innovativeness as a project requirement.*

3. Methods

3.1. Sample and Procedures

This study used questionnaire survey to gather professionals' perceptions of leadership style and innovation behavior [70–74]. Based on the literature review and pilot interviews, a questionnaire was designed, which consisted of two sections. The first section contained respondents' background information including their gender, years of working experience in the construction projects and education level. The second section asked respondents to rate survey items of all studied variables using a five-point rating scale.

The respondents of the questionnaire target the construction professionals who have a sound knowledge of construction innovation in China. To disseminate the questionnaire, the research team attended three construction innovation conferences held in China in 2017. For each conference, 50 questionnaires in hard copies were randomly sent to attendees. Additionally, the research team identified 15 construction companies that are featured in construction innovation and visited them physically for meetings. For each company, 10 questionnaires in hard copy were disseminated to the employees who got involved in adopting and applying new construction technologies or management software, and/or conducting technical improvements in construction projects. Therefore, in total, 300 questionnaires were sent out for this study. After reviewing the collected questionnaire carefully, the research team found 251 of them were valid. This sample size was acceptable for conducting the statistical analyses, in accordance with that the generally accepted rule is available when the sample size is above 30 [75,76]. Meanwhile, 30 is the smallest acceptable group number in organizational multilevel research and a group size of 5 at the lowest level is normal in longitudinal research [77]. Thus, the number of groups or project teams, the number of project members and the total sample size were sufficient to conduct the continuous analysis. The background information of the respondents (i.e., the level of education and work experience in projects) was shown in Table 1. During the survey, respondents at different levels in their organizations were requested to assess different items: those who were from leadership were asked to rate the innovativeness of their project and the innovative behavior of their subordinates; while those who were at the medium levels or below were requested to assess the items related to completed survey items on transformational leadership and innovation climate. Such a method could make the data collection more robust and convincing as it can reduce any potential common method bias [78].

Table 1. The profiles of respondents.

Gender	*N*	%	Project Experience	*N*	%	Education Level	*N*	%
Male	160	63.7	5 years and below	21	8.4	Under junior college	4	1.6
Female	91	36.3	6–10 years	126	50.2	Junior college	29	11.6
			11–15 years	87	34.6	Bachalor	103	41.0
			16–20 years	12	4.8	Master	92	36.7
			More than 20 years	5	2.0	Ph.D and above	23	9.2

Notes: *N* = number of respondents.

3.2. Measurements

Following Brislin's [79] approach, all the survey questionnaires were translated from English to Chinese, and this study adopted a five-point scale (from 1 = strongly disagree to 5 = strongly agree) in assessing the items in the survey questionnaires. All the items representing and measuring each of the four latent variables in this study are shown in Appendix A.

3.2.1. Transformational Leadership

Project members rated the transformational leadership of the project leaders or managers, based on five items (see Appendix A). These five items were adapted from Li and Shi [80] and Chen et al. [81], and the preliminary analyses indicated that their Cronbach's alpha coefficient was 0.872, indicating a satisfactory level of internal consistency reliability of the items.

3.2.2. Innovativeness as Project Requirement

Following the recommendations of Tatum [10], Zhang [82], and Yuan [67], this study adopted a four-item scale for measuring innovativeness as a project requirement (see Appendix A). The Cronbach's alpha coefficient of 0.802 supported the internal consistency reliability of the items.

3.2.3. Innovation Climate

Innovation climate was measured using nine items (see Appendix A) that were adapted from Liu and Shi [36] and Zhang et al. [83]. These items had an acceptable level of internal consistency reliability as their Cronbach's alpha coefficient was 0.905.

3.2.4. Individuals' Innovative Behaviors

"Individuals' innovative behaviors" was assessed by the project leaders or managers, based on five items (see Appendix A) that were adapted from Scott and Bruce [48] and Liu [84]. These items were also reliable because their Cronbach's alpha coefficient was 0.875.

3.3. Analytical Strategy

Prior to testing the proposed hypotheses of this research, preliminary analyses of the data were conducted. First, confirmatory factor analysis (CFA), via MPULS 7.0 software, was conducted to examine the measurement models of all the four latent variables. Additionally, the composite reliability (C.R) coefficients, average variance extracted (AVE), and correlation coefficients were calculated to assess reliability, convergent validity, and discriminant validity [85].

Next, considering the multilevel feature of the data, to differentiate the variance at the individual (team member), and project (project team) levels in hypothesis testing, hierarchical linear modeling (HLM) was applied and calculated with HLM version 6.08 software, to test the research hypotheses [86,87]. The HLM2 models could be used to estimate the individual level effects (level-1) as well as the effects of project level (level-2) variables on the intercepts and slopes at the individual level (level-1) [88]. The two-level linear models with one dependent variable (HLM2) were established to test our hypotheses, and used the group-mean-centering technique for level-1 predictors and the grand-mean-centering technique for level-2 predictors in order to test the cross-level interactive effects [89]. As for Hypothesis 1, testing the effect of transformational leadership on the innovation climate perceived by project team members (the level-1 direct effect), the random coefficients regression model in HLM could be established to predict the effects and significance of level-1 predictors [88]. As for Hypothesis 2, testing the mediation effect of innovation climate between transformational leadership and innovative behavior, considering three variables all partition into level 1, several random coefficients regression models in HLM could be also used according to the approach of Baron and Kenny [90]. When testing the cross-level effects of innovativeness as a project requirement on the relationship between transformational leadership and innovative behavior (the direct moderation effect in Hypothesis 3), as well as the cross-level effects of innovativeness as a project requirement on the relationship between innovation climate and innovative behavior (the second-stage moderation effect in Hypothesis 4), the full random coefficients model in HLM could be established with level-1 predictors and level-2 predictors.

Finally, our moderated mediation hypothesis (Hypothesis 5) was testing following Hayes' [91] approach. The PROCESS module or code in SPSS was used to test the moderated mediation model and 95% confidence intervals with 1000 iterations were used to judge the significance of the indirect effect. This approach testing a moderated mediation hypothesis builds on and extends the path analytic methods of Edwards and Lambert [92].

4. Results

4.1. Measurement Model Evaluation

CFA was used to assess the hypothesized model and examine the factor structure of the items. Widely used indices including Tucker–Lewis index (TLI), standardized root mean square residual (SRMR), root Mean square error of approximation (RMSEA), and comparative fit index (CFI) [93,94] were used to evaluate the model fit. The CFA results in Table 2 indicate that the hypothesized model with its four latent variables, transformational leadership, innovativeness as a project requirement,

innovation climate, and innovative behavior (Model 1), resulted in an excellent fit as compared with the alternative models (Models 2–4). All other alternative models resulted in a poorer fit, as demonstrated by the high χ^2/df, RMSEA, and SRMR values, and low TLI and CFI values.

Table 2. Confirmatory factor analysis (CFA) results of the expected model and alternative models.

Model #	Description	χ^2/df	RMSEA (90% CI)	TLI	CFI	SRMR
Model 1	4 factors: transformational leadership, innovativeness as a project requirement, innovation climate, and innovative behavior	2.898	0.087 (0.079; 0.095)	0.857	0.873	0.058
Model 2	3 factors: leadership variables (transformational leadership), innovativeness as a project requirement combined with innovation climate, and innovative behavior	3.901	0.107 (0.100; 0.115)	0.804	0.782	0.077
Model 3	2 factors: leader-rated variables (combined: transformational leadership, and innovative behavior), innovativeness as a project requirement combined with innovation climate	5.441	0.133 (0.126; 0.140)	0.697	0.666	0.093
Model 4	1 factors: all items loading upon the same single factor	6.080	0.142 (0.135; 0.149)	0.652	0.618	0.096

Notes: $N = 251$. Model fit indices were evaluated using the widely accepted thresholds: 0.90 for TLI and CFI [95,96]; 0.05 for a good fit; 0.08 for an acceptable fit for RMSEA [97]; and 0.08 for a good fit for SRMR [96].

Besides, the standardized factor loadings from the CFA for the four variables, transformational leadership, innovativeness as a project requirement, innovation climate, and innovative behavior (Model 1), ranged from 0.604 to 0.864. The C.R. coefficients of these four variables were 0.875, 0.817, 0.908, and 0.877, respectively, which were all greater than the threshold of 0.70 [98]. Moreover, the AVE of the variables were 0.584, 0.531, 0.524, and 0.589, respectively, which were also all greater than the threshold of 0.50 [98]. These results indicate that the measurement models are reliable and valid.

Table 3 shows the descriptive statistics, reliabilities, and correlation coefficients of the four latent variables. The results of correlation coefficients are in line with our expectations. To be precise, transformational leadership had a positive correlation with innovation climate ($\gamma = 0.551$, $p < 0.01$) as well as with innovative behavior ($\gamma = 0.459$, $p < 0.01$). This finding concurs with the findings of prior studies [21,44]. It is worth noting that all the correlation relationships among the variables were significant.

Table 3. Means, standard deviations, and correlations among the latent variables.

Variable	Mean	SD	1	2	3	4
1 Transformational leadership	3.712	0.933	(0.764)			
2 Innovativeness as a project requirement	4.046	0.816	0.576 **	(0.729)		
3 Innovation climate	3.813	0.806	0.551 **	0.475 **	(0.724)	
4 Innovative behavior	3.733	0.859	0.459 **	0.364 **	0.625 **	(0.767)

Notes: $N = 251$; SD = Standard deviation; The square roots of AVE are in the parentheses on the diagonal; ** $p < 0.01$, two-tailed test.

4.2. Result of Hypotheses Testing

Table 4 displays the results of the hypotheses testing, which was conducted in three steps: (i) Mediator = X (see Table 4 for Model 5 with innovation climate as the dependent variable); (ii) Y = X and Y = X + Mediator (the main effect model and the mediation model, respectively; see Table 4 for Models 6 and 7 with innovative behavior as the dependent variable); and (iii) Y = X + Mediator + Moderator, Y = X + Mediator + Moderator + X × Moderator, and Y = X + Mediator + Moderator + Mediator × Moderator (the main effect model and the interactive effect model, respectively; see Table 4 for Models 8–10 with innovative behavior as the dependent variable.) The model in the first step offered evidence on the effect of transformational leadership

upon innovation climate (Hypothesis 1). The models in second step offered evidence on the mediating effect of innovation climate upon the relationship amongst transformational leadership and individuals' innovative behaviors (Hypothesis 2). The models in the third step offered evidence on the moderating effect of innovativeness as a project requirement upon the connection amongst transformational leadership and innovative behavior, and the relation amongst innovation climate and innovative behavior.

As Table 4 shows, the direct effect of transformational leadership upon innovation climate was positive and significant (γ = 0.530, $p < 0.001$; Model 5). This finding indicates that Hypothesis 1 was supported. To examine the mediating effect of innovation climate, this study calculated an estimate of this indirect effect as a combination of three dissimilar paths, including group mean of transformational leadership → innovation climate (γ = 0.530, $p < 0.001$; Model 5), group mean of transformational leadership → innovative behavior (γ = 0.459, $p < 0.001$; Model 6), and group mean of transformational leadership and group mean of innovation climate → innovative behavior (γ = 0.162, $p < 0.05$; γ = 0.561, $p < 0.001$; Model 7). When the mediator of innovation climate is in Model 7, the coefficient of transformational leadership on innovative behavior decreased but remained significant as compared with Model 6. This result indicates a positive and significant mediating effect [90], which means that innovation climate partially mediated the effect of transformational leadership upon innovative behavior.

Table 4. The hypotheses testing results.

Effects	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
	Outcome: Innovation Climate		Outcome: Innovative Behavior			
	γ (*SE*)	γ (*SE*)	γ (*SE*)	γ (*SE*)	γ (*SE*)	γ (*SE*)
	Level–1 effects					
Intercept	3.813 *** (0.049)	3.733 *** (0.051)	3.733 *** (0.051)	3.733 *** (0.049)	3.733 *** (0.049)	3.733 *** (0.049)
Transformational leadership	0.530 *** (0.051)	0.459 *** (0.065)	0.162 * (0.077)	0.162 * (0.077)	0.195 ** (0.063)	0.181 * (0.072)
Innovation climate			0.561 *** (0.062)	0.561 *** (0.062)	0.559 *** (0.059)	0.553 *** (0.064)
	Cross-level effects					
Innovativeness as a project requirement				0.276 + (0.141)	0.276 + (0.141)	0.276 + (0.141)
Innovativeness as a project requirement × Transformational leadership					0.345 + (0.197)	
Innovativeness as a project requirement × Innovation climate						0.304 + (0.156)

Notes: $N_{\text{Level-1}}$ = 251; $N_{\text{Level-2}}$ = 50; *SE* = Standard error; + $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The interactive effect of innovativeness as a project requirement and transformational leadership upon innovative behavior in Hypothesis 3 was significant (γ = 0.345, $p < 0.10$; Model 9). Following Aiken and West's [99] recommendation, to probe this interaction, this research drew an interaction plot and carried out a simple slope test. Figure 2 shows the interaction plot with simple slopes for innovativeness as a project requirement at one SD below the mean and innovativeness as a project requirement at one SD above the mean. The simple slope calculated for innovativeness as a project requirement at one SD below the mean was negative and insignificant (−0.15, $p > 0.05$), as shown by the solid line in Figure 2. The simple slope computed for innovativeness as a project requirement at one SD above the mean was positive and significant (0.54, $p < 0.01$), as shown by the dashed line in Figure 2, which indicates that the moderating effect of innovativeness as a project requirement becomes noticeable at high levels. The results suggest that transformational leadership and innovativeness as a project requirement at the project level interact to affect individuals' innovative behaviors, thereby yielding support for Hypothesis 3.

The interactive effect of innovativeness as a project requirement and innovation climate on innovative behavior in Hypothesis 4 was significant (γ = 0.304, $p < 0.10$; Model 10). Again, following Aiken and West's [99] recommendation, to probe this interaction, this research drew an interaction plot and performed a simple slope test. Figure 3 shows the interaction plot with simple slopes for

innovativeness as a project requirement at one SD below the mean and innovativeness as a project requirement at one SD above the mean. The simple slope calculated for innovativeness as a project requirement at one SD below the mean was positive but insignificant (0.249, $p > 0.05$), as shown by the solid line in Figure 3. The simple slope computed for innovativeness as a project requirement at one SD above the mean was positive and significant (0.857, $p < 0.001$), as shown by the dashed line in Figure 3, which indicates that the moderating effect of innovativeness as a project requirement becomes noticeable at high levels. The results suggest that innovation climate and innovativeness as a project requirement at the project level interact to affect individuals' innovative behaviors, thereby yielding support for Hypothesis 4.

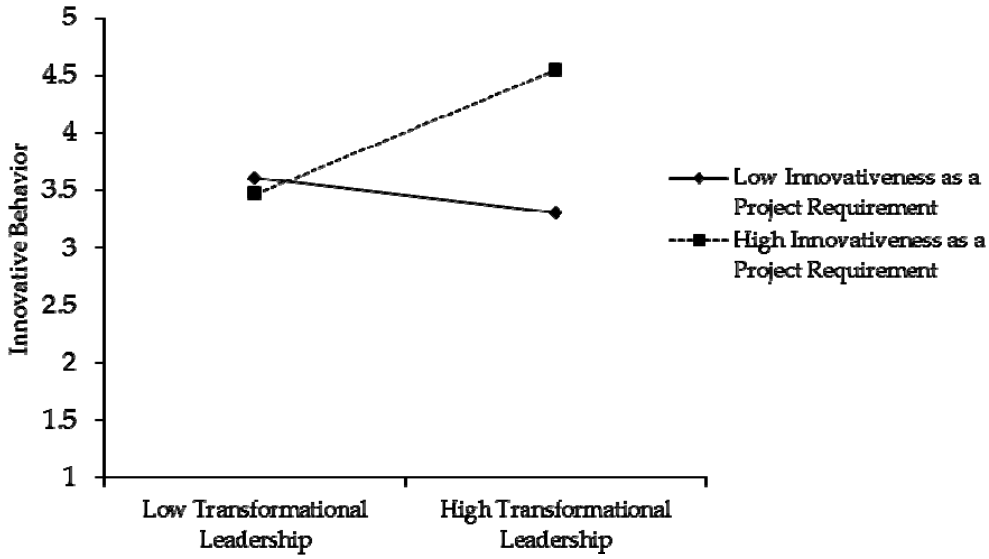

Figure 2. The interactive effect of transformational leadership and innovativeness as a project requirement on innovative behavior.

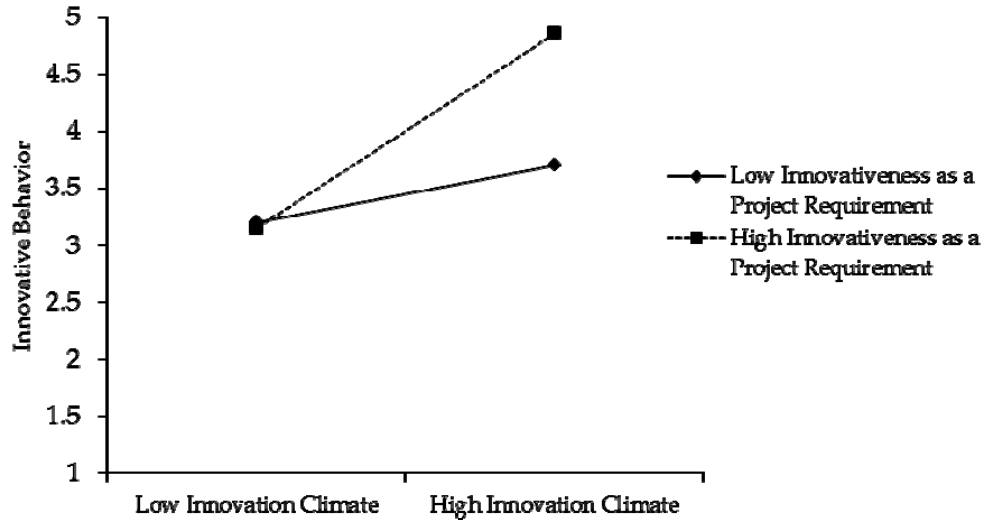

Figure 3. The interactive effect of innovation climate and innovativeness as a project requirement on innovative behavior.

In order to test Hypothesis 5, which predicts the moderating effect of innovativeness as a project requirement upon the indirect relation amongst transformational leadership and innovative behavior through innovation climate, this study computed the estimates of the conditional indirect effects

of innovativeness as a project requirement at low (mean −1 SD) and high (mean +1 SD) values of the moderator, innovativeness as a project requirement. Using SPSS version 22.0, the PROCESS module, and 95% Bias Corrected Confidence Intervals (95% BC CI), the computation was executed according to the method developed by Hayes [91]. In order to represent which values of the moderator are meaningful, the moderator is artificially categorized into different groups, such as three levels (low, middle, and high level in Table 5) of the continuous moderator, innovativeness as a project requirement, mean that minus one SD from mean, the mean, and plus one SD from mean. As Table 5 indicates, an estimate of the conditional indirect effect of transformational leadership upon innovative behavior at a low level of innovativeness as a project requirement was positive and significant, i.e., 0.222, 95% BC CI (0.116; 0.342). The estimate at a high level of innovativeness as a project requirement was also positive and significant, i.e., 0.323, 95% BC CI (0.223; 0.471). Besides, according to Aiken and West [99] and Hayes [91], when any two conditional indirect effects defined by different values of the moderator are statistically different, the moderator is associated with the indirect effect. These results in Table 5 indicate that the mediating effects of innovation climate upon the relation amongst transformational leadership and innovative behavior at different levels of the moderator (i.e., innovativeness as a project requirement) were positive and significant. Thus, any two indirect effects of transformational leadership on innovative behavior through innovation climate conditioned on different levels of innovativeness as a project requirement are statistically significant, and the bootstrap confidence intervals for the different conditional indirect effects does not include zero. This analysis yields support for Hypothesis 5.

Table 5. The mediating effect of innovation climate at different levels of innovativeness as a project requirement.

Different Levels of Innovativeness as a Project Requirement	Indirect Effect Coefficients	Standard Error	95% Bias Corrected Confidence Intervals
Low level of innovativeness as a project requirement	0.222	0.059	[0.116; 0.342]
Middle level of innovativeness as a project requirement	0.276	0.044	[0.204; 0.383]
High level of innovativeness as a project requirement	0.323	0.061	[0.223; 0.471]

5. Discussion and Implications

5.1. Discussion

The growing significance of leadership within project organizations has motivated researchers to explore the complex, inner mechanisms in the role of leadership. The focus of innovation in construction has attracted scholars to designate leadership as one of the antecedents. However, there is a gap within the body of knowledge about composite mediating and moderating effects upon the process of motivating individuals' innovation outcomes. This study analyzed the process of stimulating project members' innovative behaviors via transformational leadership, innovation climate, and the cross-level role of innovativeness as a project requirement in determining the strength of the relations amongst transformational leadership, innovation climate and individuals' innovative behaviors. This study empirically tested how project members' perceptions of their leader's transformational styles, innovation climate of their organizations, and innovativeness as a project requirement influences members' innovative performances, i.e., individuals' innovative behaviors.

In line with Chan et al. [21], the results of the present study show that transformational leaders develop the innovation climate among project members. Extending Chan et al.'s [21] findings, this study also discovered a positive correlation between innovation climate and individuals' innovative behaviors. Moreover, in line with Wang et al.'s [62] and Jaiswal et al.'s [57] findings, the empirical findings of the present research imply that innovation climate is positively correlated to employees' innovation outcome and support the presence of significant mediating effects of innovation climate upon the connection among transformational leadership and innovative behavior.

Transformational leaders in projects could do more to motivate project members' innovative behaviors if the members perceive that they are in a supportive climate. Leaders could also form a mutual belief in or vision of innovation. If they perceive the climate as supportive of innovation, individuals would perform better in generating creative ideas, seeking available resources, and implementing innovation schemes under transformational leadership.

Consistent with what has been found in previous studies (e.g., Gumusluoglu and Ilsev [64]), in a collectivist culture such as that of China, transformational leaders are more favorable to exert their role in individuals' innovation outcomes. Additionally, the research findings indicate that when the project requirement for innovativeness is higher or the project goals focus more on innovation, members' perceptions of the project's transformational leadership or the organizational climate's support for innovation are predictive of significant improvements in innovative behaviors. Thus, construction projects should require or emphasize innovation in order to encourage individuals' innovative endeavors. This study confirms the cross-level effect of innovativeness as a project requirement in determining the strength of the relationships among transformational leaders, the perceived innovation climate, and innovative behavior. The results suggest that the role of project requirements or goal-setting is more complicated than what had been previously thought. Innovativeness as a project requirement serves as a contextual factor enhancing the leadership-related and climate-related influences, i.e., if project leaders strive to shape project members' innovative attitudes or behaviors, the impact of transformational leadership is likely to be more successful not only in a supportive climate but also when construction projects have a strong requirement for innovativeness.

This study also confirms that individuals' innovative behaviors are influenced by the self-rated factors and their high-level effects (e.g., at the project or group level) of the temporary nature of construction projects. Although previous studies found a positive effect of leadership on the success of construction projects [19,20], few have specified the moderating effects of innovativeness as a project requirement on individuals' outcomes. Therefore, this research contributes to extending and enriching the extant leadership theory [46] and the viewpoint of "need-pull innovation or technology-push innovation" in construction innovation.

5.2. Implications

The present research has implications for both theory and practice. This research examined the role of transformational leadership in predicting innovation climates and innovative behaviors, and then attempted to incorporate the leadership theory and innovation climate into a construction project setting. Due to the transformational leadership's positive impacts upon innovation climate as well as innovative behavior, transformational leaders stimulate employees' intelligence by encouraging and supporting employees to think and work differently. According to the transformational approach of leadership, project members would be promoted and motivated to be creative and generate innovative solutions to difficult problems on construction sites.

The evidence regarding the mediating role of the perception of an innovation climate is practically important. First, employees' mutual belief in a supportive innovation climate in construction projects may be lasting if a construction firm's strategies are not effectively enacted at the project level. Second, an innovation climate acts as another antecedent of employees' innovative behaviors. It is also important to establish a reliable climate in project teams or organizations. Hence, this study provides an appropriate basis for managers or leaders to enhance the mutual vision, beliefs, or values of project members and build a supportive innovation climate.

It is noteworthy that the moderating role of innovativeness as a project requirement functions on the direct effect of transformational leadership or innovation climate on innovative behavior and on the indirect relation amongst transformational leadership and innovative behavior via an innovation climate. The findings lead this study to advocate for project organizations setting relevant goals for innovation or formulating strategies to specify innovativeness in projects in order to strengthen the relationship between leaders and project members. These measurements should be designed and

implemented to increase the cognition of the project members, facilitate the promotion of the leaders' approach, and enhance the mutual understanding between project managers and members.

5.3. Limitations and Future Research Directions

Despite achieving the objectives, the present study has certain limitations that warrant future research and must also be taken into account when interpreting and generalizing the findings. First, this study applied a cross-sectional sampling approach, which cannot describe the causal relationship among the variables. Thus, the longitudinal way of collecting data is recommended for exploring the dynamic relation among leadership and innovation outcomes in construction projects. Second, this research was conducted in the construction industry and at the project level in China. Future studies may extend to other sectors and/or compare results from different kinds of projects, as well as pay attention to other factors (e.g., barriers, the lack of clear benefits, temporary features [19]) for a deeper understanding of the complex mechanisms from different perspectives.

6. Conclusions

Drawing upon leadership contingency theory, social cognitive theory, and construction innovation literature, this research tested the role of transformational leadership in impacting upon innovative behavior amongst the team members of construction projects, as well as examined the mediating effects of the members' perception of the innovation climate in project-based organization and the cross-level moderating effects of innovativeness as a project requirement. The results indicated that transformational leaders positively develop an innovation climate and motivate individuals' innovative behaviors in construction projects. Moreover, innovation climate plays an intervening role between transformational leadership and innovative behavior while innovativeness as a project requirement acts as a boundary condition under which the effect of transformational leadership and the indirect effect of innovation climate are more pronounced. The findings provide directions for project leaders or managers in which to train their competencies and reform their project environments such that project members would perceive the presence of innovative support for the project organizations or themselves. In addition, innovativeness, which could be made as a requirement at the beginning of a project or considered as one part of project goals, is beneficial for the motivation of innovation in construction projects.

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Appendix A

The table below shows the items representing and measuring the four latent variables involved in this study.

Table A1. Latent variables and their respective measurement items.

Latent Variables	Measurement Items
Transformational leadership	1. The leader or manager focuses on giving individual consideration to each project team member.
	2. The leader or manager positively highlights the importance of the project goal and value in order to develop the team attitude and spirit amongst project members.
	3. The leader or manager inspires us to work towards the same goal through work passion.
	4. The leader or manager asks questions that prompt others to think.
	5. The leader or manager works and shares together with us in the construction process.
Innovativeness as a project requirement	1. The project always requires trying out new approaches to difficult problems.
	2. Introducing new ideas into the organization is part of the project goals.
	3. The tasks in construction projects include searching for new technologies and techniques.
	4. We need to be innovative to fulfill our tasks requirements in construction projects.
Innovation climate	1. The organization appreciates the innovative member with entrepreneurial spirit in the construction process.
	2. The organization will award the members for the innovative ideas.
	3. The organization advocates the new attempt and learning from mistakes.
	4. My leader respects and tolerates the different opinions.
	5. My leader encourages us to propose solutions to improve the production or service.
	6. My leader would support and assistant us to accomplish the creative ideas related to the construction projects.
	7. We support and help each other in the construction process.
	8. We would like to share ideas, methods, and techniques in the construction process.
	9. We would exchange and discuss the proposed creative ideas.
Innovative behavior	1. The members always generate creative ideas or new solutions.
	2. The members would encourage and champion ideas to others.
	3. The members explore and secure funds or resources required for implementing new ideas.
	4. The members establish adequate plans and schedules for implementing new ideas.
	5. The members would contribute suggestions or approaches for others' creative ideas.

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