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GREEN INNOVATION IN BATAM CONSTRUCTION COMPANIES: THE ROLE OF ORGANIZATIONAL CLIMATE AND CORPORATE GOVERNANCE

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Abstract
The construction industry is one of the most environmentally intensive sectors, making green innovation an essential strategy for improving environmental sustainability and organizational competitiveness. This study aims to analyze the effects of organizational climate, corporate governance, and employee intellectual capability on green innovation, as well as to examine the moderating role of green transformational leadership in construction companies in Batam City, Indonesia. The study employed a quantitative approach using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with SmartPLS 4.0. Data were collected from 82 employees working in construction firms through purposive sampling and measured using a Likert-scale questionnaire. The findings indicate that organizational climate, corporate governance, and employee intellectual capability each have a positive and significant effect on green innovation, with employee intellectual capability emerging as the strongest predictor. Green transformational leadership also has a direct positive effect on green innovation. However, it does not significantly moderate the relationship between organizational climate, corporate governance, employee intellectual capability, and green innovation. These results suggest that internal organizational factors and employee capacity play a central role in encouraging green innovation. The study concludes that strengthening intellectual capability, fostering a supportive organizational climate, and implementing sound corporate governance are key strategies for promoting green innovation in construction companies.

Keywords: Green Innovation; Organizational Climate; Corporate Governance; Intellectual Capability; Construction Industry

1. Introduction

The construction industry is one of the most environmentally intensive sectors because of its high consumption of energy, raw materials, and natural resources, as well as its contribution to waste generation and carbon emissions (Tang et al., 2020). In this research, green innovation has become increasingly important as a strategic approach that enables firms to develop environmentally responsible products, processes, and management systems while maintaining competitiveness and long-term sustainability (Yin, 2026). Green innovation is not only relevant for environmental compliance, but also for strengthening business resilience in response to growing regulatory and market pressures (Singh et al., 2020). In Indonesia, this issue is particularly urgent because rapid economic growth and industrial expansion continue to intensify environmental degradation, making sustainability-oriented business practices a necessity rather than an option (Sofiyan et al., 2026).

In construction firms, green innovation extends beyond the use of eco-friendly materials. It also includes efficient resource utilization, environmentally oriented work processes, sustainable technology adoption, and managerial practices that support environmental responsibility (Lubis, Syaifuddin, Lubis, et al., 2023). However, the realization of green innovation depends heavily on internal organizational conditions. A supportive organizational climate can foster openness, collaboration, and creativity; corporate governance can provide strategic direction, accountability, and consistency in sustainability implementation; and employee intellectual capability can supply the analytical and problem-solving capacity needed to transform green ideas into operational practice (Susanto et al., 2025). These factors indicate that green innovation is not merely a technical outcome, but also an organizational and human resource issue (Faris et al., 2024).

Initial evidence from construction companies in Batam City shows that green innovation has begun to emerge, but its implementation remains limited and inconsistent. The pre-survey results indicate that most respondents agreed that their companies had encouraged environmentally friendly work practices, energy saving, support for green technology or processes, environmental innovation, and sustainability-oriented policies. Nevertheless, a considerable proportion of employees still responded "moderate," suggesting that green innovation has not yet been fully institutionalized across the organization.

Table 1. Pre-Survey of Green Innovation in Construction Companies in Batam City

Statement	Disagree (1)	Moderate (2)	Agree (3)
The company encourages environmentally friendly work practices	1 (3.3%)	12 (40.0%)	17 (56.7%)
The company saves energy and resources	1 (3.3%)	10 (33.3%)	19 (63.3%)
The company supports environmentally friendly technology/work processes	2 (6.7%)	7 (23.3%)	21 (70.0%)
The company encourages environmental innovation	3 (10.0%)	11 (36.7%)	16 (53.3%)
The company has policies oriented toward environmental sustainability	2 (6.7%)	10 (33.3%)	18 (60.0%)

Source: Pre-survey of Construction Companies in Batam City (2025)

These findings point to an important gap between employees' general awareness of environmental practices and the actual organizational capacity to implement green innovation consistently. Field observations indicate that organizational climate in these firms is still unstable, communication and work instructions are not always clear, support for employee ideas remains limited, and corporate governance mechanisms are not yet fully standardized, transparent, or accountable. At the same time, although many employees show adequate intellectual capability in understanding procedures, solving problems, and adapting to change, their potential has not been optimally translated into green innovation because of limited training, weak organizational support, and the absence of structured systems for idea development and implementation. This condition suggests that green innovation in Batam construction firms is still at an early stage and requires stronger organizational foundations.

Another issue concerns the role of green transformational leadership. Prior studies have shown that leadership emphasizing environmental vision, green role modeling, and inspirational motivation can promote environmentally responsible behavior and support

sustainability performance. However, in the Batam construction context, leadership support for environmental concerns is still perceived as relatively weak, indicating that green transformational leadership may not yet function optimally in strengthening internal drivers of green innovation. At the same time, previous studies (Bhastary et al., 2024)(Marini et al., 2023)(Cegarra-Navarro et al., 2024) has largely examined organizational climate, governance, intellectual capability, or green leadership separately, often in large firms or manufacturing settings. Limited research (Zhang et al., 2023), (Ahmed et al., 2023) has integrated these variables in the context of growing small- and medium-scale construction companies, particularly in developing regions where governance systems and sustainability commitments are still evolving.

Based on this gap, this study aims to examine the effects of organizational climate, corporate governance, and employee intellectual capability on green innovation, and to analyze the moderating role of green transformational leadership in construction companies in Batam City.

This study contributes theoretically by enriching the literature on green innovation through an integrative framework that links organizational, governance, human capability, and leadership factors in one model. Practically, the study provides insights for construction firms on how to strengthen internal organizational conditions to support green innovation more effectively. This article is organized into five sections: introduction, research method, results, discussion, and conclusion.

2. Theoretical Background

2.1 Resource-Based View

This study is grounded in the Resource-Based View (RBV), which explains that sustainable competitive advantage is achieved when firms possess resources that are valuable, rare, inimitable, and non-substitutable (Karim et al., 2022). in this perspective, human resources are not merely operational inputs but strategic assets that contribute to long-term organizational performance, innovation, and sustainability (Astika et al., 2022). employee knowledge, skills, experience, creativity, and intellectual capability constitute important internal resources that determine whether an organization can respond effectively to environmental challenges and transform them into innovative outcomes (Hasrul Azwar Hasibuan et al., 2022). for construction companies, rbv is highly relevant because green innovation does not rely solely on physical assets or technology, but also on the quality of internal organizational conditions and the capability of employees to generate and implement environmentally responsible ideas. thus, organizational climate, corporate governance, intellectual capability, and leadership can be understood as internal strategic resources that shape the firm's ability to achieve green innovation (Khanra et al., 2022).

2.2 Green Innovation

green innovation refers to the ability of a company to develop and implement products, processes, technologies, and managerial practices that reduce environmental harm, improve resource efficiency, and support sustainability while maintaining competitiveness (Ihsan Agung et al., 2024). prior studies describe green innovation as an innovation orientation that integrates economic and environmental goals through low-emission technology, efficient use of materials and energy, waste reduction, and environmentally friendly products or services (Isrososiawan et al., 2021). in organizational settings, green innovation is important because it helps firms respond to

stakeholder pressure, environmental regulation, and the increasing need for sustainable business practices (Obaid & Alias, 2015). in the construction sector, green innovation is particularly important because project activities directly affect material use, waste generation, emissions, and energy consumption. therefore, green innovation is not limited to technical change, but also includes managerial commitment and operational redesign toward environmental sustainability (Susanto, 2025). Green innovation in this study is reflected through four indicators (Khanra et al., 2022), namely green product, green process innovation, environmentally friendly technology, and sustainable management methods. green product refers to products or services that are environmentally friendly, energy-efficient, and recyclable. Green process innovation refers to the implementation of more efficient work or production processes that reduce waste, emissions, and excessive resource use. environmentally friendly technology refers to the use of technologies that lower pollution and support sustainable operations (Honkley et al., 2025).

2.3 Green Transformational Leadership

Green transformational leadership is a leadership style that combines transformational leadership principles with environmental sustainability values (Chen et al., 2014). it emphasizes the leader's ability to communicate a green vision, inspire employees to participate in sustainability-related actions, demonstrate environmentally responsible behavior, and encourage innovative solutions to environmental challenges (Avolio & Yammarino, 2013). previous studies indicate that green transformational leadership plays an important role in shaping employee green behavior, organizational green culture, environmental performance, and green innovation (Danirmala, 2022). however, several studies (Wulan Dari et al., 2023)(Fadli, 2024) also suggest that its effectiveness depends on the presence of supporting organizational systems, such as green human resource practices, a supportive climate, and consistent policies. this means that leadership alone may not be sufficient, but it can act as a powerful catalyst that strengthens the relationship between internal organizational factors and green innovation.

2.4 Organizational Climate

organizational climate refers to employees' shared perceptions of the internal work environment of the organization. it reflects how employees experience organizational policies, work standards, support systems, communication patterns, interpersonal relationships, and the overall atmosphere of the workplace (Danirmala, 2022). a positive organizational climate is usually characterized by clear structure, supportive leadership, harmonious relationships, and a comfortable working environment. such conditions are important because they influence employee motivation, commitment, innovative behavior, and willingness to engage in organizational change (Sipayung et al., 2023). from a behavioral perspective, organizational climate is not limited to physical working conditions, but also includes the psychological atmosphere that shapes how employees interpret and respond to organizational practices (Shah et al., 2024). Organizational climate is important for green innovation because employees are more likely to support environmentally responsible practices when they work in an open, supportive, and creative environment (Hou et al., 2022). In this study, organizational climate is measured through four indicators (Suryani, 2023): organizational structure, work standards and support, interpersonal relationships, and employee perceptions of the work environment.

These indicators reflect the main dimensions of organizational climate that are relevant to innovation and sustainability.

2.5 Corporate Governance

Corporate governance refers to the system of principles, policies, structures, and control mechanisms used to direct and manage the company in a transparent, accountable, responsible, independent, and fair manner (Khoury, 2022). The governance literature emphasizes that sound corporate governance is essential for improving organizational performance, reducing agency conflict, strengthening internal control, and ensuring long-term sustainability (Karsono, 2023). Governance is not only a matter of formal compliance but also a mechanism that shapes how decisions are made, how resources are allocated, how responsibilities are monitored, and how stakeholder interests are balanced (Ausloos, 2021). In sustainability-related contexts, corporate governance becomes important because it can translate environmental commitment into organizational rules, priorities, monitoring practices, and accountability systems (McGahan, 2021).

Corporate governance supports green innovation by translating sustainability strategy into consistent operational practice (Almadana-Abón et al., 2024). in this study, it is measured through five indicators: transparency, accountability, responsibility, independence, and fairness, which reflect the core principles of good corporate governance in supporting environmentally responsible practices. intellectual capability refers to employees' cognitive ability to think logically, analyze problems, make decisions, and learn from new information (Wirata et al., 2025). in the context of green innovation, this capability helps employees understand environmental issues and develop practical, sustainable solutions. in this study, intellectual capability is measured through four indicators: logical thinking ability, problem analysis ability, decision-making ability, and learning ability (Maier, 2021).

2.6 Hypotheses

1) *H1: organizational climate is hypothesized to have an effect on green innovation.*
2) *H2: corporate governance is hypothesized to have an effect on green innovation.*
3) *H3: intellectual capability is hypothesized to have an effect on green innovation.*
4) *H4: organizational climate is hypothesized to have an effect on green*
5) *Innovation, moderated by green transformational leadership.*
6) *H5: corporate governance is hypothesized to have an effect on green innovation, moderated by green transformational leadership.*
7) *H6: intellectual capability is hypothesized to have an effect on green innovation, moderated by green transformational leadership.*
8) *H7: green transformational leadership is hypothesized to have an effect on green innovation.*

3. Methods

This study employed a quantitative approach to examine the effects of organizational climate, corporate governance, and intellectual capability on green innovation, with green transformational leadership as a moderating variable, in construction companies in Batam City. The population consisted of 457 employees, and a sample of 82 respondents was determined using the Slovin formula with a 10% margin of error. Respondents were selected based on three criteria: being active employees at the time of the study, having worked for at least three months, and being willing to complete the questionnaire. Data

were collected through closed-ended questionnaires using a five-point Likert scale and distributed both directly and online via Google Forms. The collected data were then analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) (Gozali, 2018), which included outer model evaluation through convergent validity, discriminant validity, Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE), followed by inner model evaluation using R-square, Q-square, and bootstrapping to test the significance of the structural paths, where hypotheses were accepted when the t-statistic exceeded 1.96 and the p-value was below 0.05.

4. Results and Discussion

4.1 Descriptive Analysis

Table 2. Descriptive Summary of Research Variables

Variable	Indicator	Mean	Category
Green Innovation	Green Product	2.77	Needs improvement
	Green Process Innovation	2.79	Needs improvement
	Environmentally Friendly Technology	2.77	Needs improvement
	Sustainable Management Methods	2.77	Needs improvement
Green Transformational Leadership	Environmental Vision	4.14	Maintained
	Green Role Modeling	4.13	Maintained
	Green Inspirational Motivation	4.11	Needs improvement
	Green Intellectual Stimulation	4.14	Maintained
Organizational Climate	Organizational Structure	3.93	Needs improvement
	Work Standards and Support	3.95	Needs improvement
	Interpersonal Relationships	3.97	Needs improvement
	Work Environment Perception	3.96	Needs improvement
Corporate Governance	Accountability	4.07	Needs improvement
	Responsibility	4.10	Maintained
	Independence	4.09	Maintained
	Fairness and Equality	4.10	Maintained
Intellectual Capability	Logical Thinking Ability	3.79	Needs improvement
	Analytical Ability	3.88	Needs improvement
	Decision-Making Ability	3.88	Needs improvement
	Learning and Understanding New Information	3.86	Needs improvement

Table 1 indicates that green innovation remains the weakest construct, because all of its dimensions are still below the expected benchmark. This means that green products, green processes, environmentally friendly technology, and sustainable management methods have not yet been implemented optimally. In contrast, green transformational leadership shows relatively strong results, especially in environmental vision and green intellectual stimulation, although green inspirational motivation still needs improvement.

The table also shows that organizational climate still requires improvement across all dimensions, even though interpersonal relationships recorded the highest mean. Corporate governance appears relatively stronger, particularly in responsibility and fairness, but accountability still needs reinforcement. Intellectual capability also remains below the expected threshold, although analytical ability and decision-making ability show comparatively better results than logical thinking ability. Overall, the descriptive findings suggest that leadership and governance are relatively better developed than green innovation, organizational climate, and intellectual capability.

4.2 Convergent Validity

Table 3. Outer Loading Summary

Construct	Outer Loading Range	Decision
Green Innovation (IH)	0.781–0.888	Valid
Organizational Climate (IO)	0.820–0.931	Valid
Intellectual Capability (KI)	0.729–0.936	Valid
Green Transformational Leadership (TKH)	0.746–0.930	Valid
Corporate Governance (TKP)	0.900–0.943	Valid

Table 3 shows that all indicators have outer loading values above 0.70. This means that every indicator is sufficiently strong in representing its respective construct. Corporate governance has the strongest indicator range, followed by organizational climate, while intellectual capability and green transformational leadership still remain within acceptable validity levels. Therefore, all indicators were retained for further analysis.

Table 4. Average Variance Extracted (AVE)

Construct	AVE	Decision
Green Innovation (IH)	0.698	Valid
Organizational Climate (IO)	0.817	Valid
Intellectual Capability (KI)	1.000	Valid
Green Transformational Leadership (TKH)	0.662	Valid
Corporate Governance (TKP)	1.000	Valid

Table 4 indicates that all AVE values exceed the minimum threshold of 0.50. This confirms that each construct explains more than half of the variance of its indicators. Accordingly, the model satisfies convergent validity requirements and can proceed to discriminant validity testing.

4.3 Discriminant Validity

Table 5. Selected HTMT Values

Construct Pair	HTMT Value	Decision
IH – IO	0.615	Valid
IH – KI	0.507	Valid
IH – TKH	0.577	Valid

Construct Pair	HTMT Value	Decision
IH – TKP	0.205	Valid
IO – KI	0.240	Valid
IO – TKH	0.260	Valid
KI – TKH	-0.071	Valid
TKH – TKP	0.178	Valid
Highest interaction-related value	0.602	Valid

Table 5 shows that all HTMT values are below 0.90, which confirms discriminant validity. The values between green innovation and the other constructs are moderate to low, indicating that the constructs are empirically distinct. The same pattern is found among the independent variables and the interaction terms, meaning that the moderating constructs are not excessively similar to the main variables. Therefore, each construct uniquely measures a different concept in the model.

4.4 Reliability

Table 6. Reliability Results

Construct	Cronbach's Alpha	Composite Reliability	Decision
Green Innovation (IH)	0.938	0.949	Reliable
Organizational Climate (IO)	0.968	0.973	Reliable
Intellectual Capability (KI)	0.926	0.940	Reliable
Green Transformational Leadership (TKH)	0.925	0.939	Reliable
Corporate Governance (TKP)	0.976	0.979	Reliable
IO × TKH	1.000	1.000	Interaction term
KI × TKH	1.000	1.000	Interaction term
TKP × TKH	1.000	1.000	Interaction term

Table 6 indicates that all main constructs have Cronbach's Alpha and Composite Reliability values above 0.70, which confirms strong internal consistency. The perfect scores for the interaction terms should be interpreted cautiously, because these moderation variables were formed from product indicators rather than from multiple reflective items. Overall, the measurement model can be considered reliable.

4.5 Hypothesis Testing

Table 7. Path Coefficient Results

Relationship	Original Sample (β)	t-statistic	p-value	Decision
Organizational Climate → Green Innovation	0.389	6.115	0.000	Supported
Organizational Climate × GTL → Green Innovation	0.035	0.744	0.457	Not supported
Intellectual Capability → Green Innovation	0.501	7.125	0.000	Supported

Relationship	Original Sample (β)	t-statistic	p-value	Decision
Intellectual Capability × GTL → Green Innovation	0.011	0.217	0.829	Not supported
Green Transformational Leadership → Green Innovation	0.468	7.071	0.000	Supported
Corporate Governance → Green Innovation	0.272	2.903	0.004	Supported
Corporate Governance × GTL → Green Innovation	-0.002	0.028	0.977	Not supported

Table 6 shows that four direct relationships are positive and significant: organizational climate, intellectual capability, green transformational leadership, and corporate governance all significantly affect green innovation. Intellectual capability is the strongest predictor, followed by green transformational leadership, organizational climate, and corporate governance. In contrast, none of the three moderation effects are significant, which means that green transformational leadership does not strengthen the effects of organizational climate, intellectual capability, or corporate governance on green innovation.

4.6 Coefficient of Determination

Table 7. R-Square Results

Dependent Variable	R Square	Adjusted R Square
Green Innovation	0.822	0.805

Table 7 shows that the model explains 82.2% of the variance in green innovation, while the adjusted R-square remains high at 0.805. This indicates that the model has very strong explanatory power, and that organizational climate, corporate governance, intellectual capability, and green transformational leadership jointly account for most of the variation in green innovation.

4.7 Discussion

4.7.1 The Effect of Organizational Climate on Green Innovation

The results demonstrate that organizational climate has a positive and significant effect on green innovation. This means that a more conducive work environment, characterized by clearer communication, better support, and stronger interpersonal relationships, encourages employees to engage in environmentally oriented innovation. In the context of Batam construction firms, organizational climate functions as a practical internal condition that directly influences employees' readiness to support green ideas in everyday operations. This finding is consistent with previous studies showing that organizational climate encourages innovative work behavior and green-oriented practices. The descriptive results strengthen this interpretation because interpersonal relationships recorded the highest mean among the dimensions of organizational climate, even though the overall construct still needs improvement. This suggests that employees respond more strongly to collaborative and respectful work relationships than to formal structure alone. Thus, organizational climate acts as a contextual resource that encourages green innovation directly.

This finding is supported by previous studies. (Amelia, 2020), (L. Jean Harrison-Walker, 2022) found that organizational climate positively affects innovative work behavior. (Sirait et al., 2021) also reported that a conducive organizational climate

encourages green innovation and climate positively influences employees' innovative behavior. These studies strengthen the present result that organizational climate plays an important role in promoting green innovation. Managerial implication. Managers should improve communication quality, strengthen team coordination, and create a more supportive and psychologically safe work environment. In project-based construction settings, a better climate can become an immediate driver of green innovation without waiting for major structural changes.

4.7.2 The Effect of Corporate Governance on Green Innovation

Corporate governance also has a positive and significant effect on green innovation. This indicates that governance principles such as accountability, responsibility, independence, and fairness provide a formal foundation for sustainability-oriented decisions and operational control. In other words, governance helps translate environmental commitment into actual procedures, responsibilities, and implementation practices. This finding supports earlier studies that identify governance as an important mechanism for sustainability and long-term competitiveness. However, the size of its effect is smaller than that of intellectual capability and green transformational leadership. This suggests that governance in these firms still operates more as a compliance system than as a proactive innovation system. The descriptive findings also show a notable gap within the independence dimension, especially in the item related to fairness and professionalism of leadership, which scored much lower than the other items. This indicates that governance is relatively strong at the formal level, but not yet fully internalized in daily project management.

This finding is supported by previous studies. (Du et al., 2024), (Hou et al., 2022) found that corporate governance plays an important role in promoting environmental sustainability and innovation. (Nasib et al., 2023)reported that green governance supports sustainability disclosure as part of the green innovation agenda. Managerial implication. Construction firms should move beyond formal governance documents and ensure that accountability, objectivity, and fairness are visible in daily work practices. Governance will support green innovation more strongly when employees experience it as a practical and credible system, not merely as procedural compliance.

4.7.3 The Effect of Intellectual Capability on Green Innovation

Intellectual capability is the strongest predictor of green innovation in this study. This finding means that employees' ability to think logically, analyze work problems, make proper decisions, and absorb new information is the most influential internal resource for encouraging green innovation. In construction firms, green innovation often depends on employees' ability to identify inefficiencies, solve technical issues, and adapt work methods toward more environmentally responsible solutions. This result is aligned with previous studies showing that intellectual capability and intellectual capital positively affect innovative behavior and sustainable performance. This result is particularly important because the descriptive analysis shows that intellectual capability still needs improvement overall. This implies that intellectual capability in this context is not determined only by formal education, but also by field experience and practical problem-solving exposure. In Batam construction firms, this makes intellectual capability a strategic internal resource that directly translates into innovation output.

This finding is supported by previous studies. (Lubis, Syaifuddin, Sofiyan, et al., 2023) found that human resource capability and intellectual capability play an important

role in green innovation. (Ahmed et al., 2023) reported that intellectual capital has a positive and significant effect on innovative work behavior. Managerial implication. Managers should prioritize employee development through technical training, analytical problem-solving workshops, mentoring, and continuous learning systems. Since intellectual capability is the strongest driver, investment in employee capability development is likely to produce the greatest direct benefit for green innovation.

4.7.4 The Moderating Role of Green Transformational Leadership on the Relationship between Organizational Climate and Green Innovation

The moderation effect of green transformational leadership on the relationship between organizational climate and green innovation is not significant. This indicates that organizational climate already exerts a direct influence on green innovation without requiring reinforcement from leadership as an interaction effect. A conducive climate appears to be sufficient to stimulate employees' environmentally oriented innovation behavior. In this sense, green transformational leadership works more effectively as an independent predictor than as a moderator of climate. One explanation is that many respondents are young employees with relatively short tenure, making them more responsive to their daily work environment and peer relationships than to leadership as a strengthening mechanism. Since interpersonal relationships already emerged as the strongest climate dimension, organizational climate itself may be the more immediate influence on green innovation.

This result is in line with previous studies. (Yanti & Nawangsari, 2019) found that green transformational leadership had a positive but statistically insignificant relationship with employee green behavior. (Lubis, Nasib, Syaifuddin, et al., 2023) reported that although green transformational leadership supports environmental performance, its indirect role through green innovation was not significant. Managerial implication. Management should not rely only on leadership programs to enhance the effect of organizational climate. The more practical strategy is to improve the climate itself, especially work structure, communication, and support systems, because these factors already influence green innovation directly.

4.7.5 The Moderating Role of Green Transformational Leadership on the Relationship between Corporate Governance and Green Innovation

Green transformational leadership also does not significantly moderate the relationship between corporate governance and green innovation. This implies that governance and leadership operate through separate channels in this model. Governance influences green innovation through formal rules and procedural control, while leadership influences it through direct inspiration and behavioral guidance. Because governance in these firms still appears partly procedural, leadership has not been able to strengthen its impact significantly. This finding is also understandable from the respondent profile. Employees with short tenure and mostly mid-level educational backgrounds may experience governance mainly as rules, reporting procedures, and job accountability rather than as a strategic sustainability system. Under these conditions, leadership cannot easily transform governance into a stronger innovation mechanism because the governance base itself is not yet fully embedded in employees' understanding.

This result is also supported by previous studies (Arslan & Alqatan, 2020) found that corporate governance encourages sustainability practices, including green innovation. (Muslim, 2023) reported that leadership and organizational culture influence the quality

of corporate governance. Managerial implication. Companies should first make governance more operationally meaningful and visible to employees. Governance must be experienced as fair, objective, and useful in daily project execution before leadership can effectively reinforce it for green innovation purposes.

4.7.6 The Moderating Role of Green Transformational Leadership on the Relationship between Intellectual Capability and Green Innovation

The moderation effect of green transformational leadership on the relationship between intellectual capability and green innovation is also not significant. This means that intellectual capability already contributes directly to green innovation without needing further strengthening from leadership. Employees with adequate intellectual capability appear able to solve technical and environmental problems independently, especially in the construction context, where work challenges are practical and immediate. This finding suggests that intellectual capability behaves as a self-directed internal resource. Because employees' capability is strongly shaped by field experience and technical exposure, its influence on green innovation is already direct and immediate. Under these conditions, leadership does not significantly enhance the effect because employees' problem-solving capacity is already functioning close to the operational process itself. Managerial implication. Firms should develop intellectual capability directly instead of expecting leadership to activate it indirectly. Structured technical development, knowledge sharing, and green construction training are likely to be more effective than relying on leadership style alone to increase the contribution of employee capability to green innovation.

4.7.7 The Effect of Green Transformational Leadership on Green Innovation

Green transformational leadership has a positive and significant direct effect on green innovation. This means that leaders who communicate a clear environmental vision, demonstrate green behavior, and stimulate employees to think creatively about sustainability can directly promote green innovation in construction firms. This finding is consistent with prior studies that identify green transformational leadership as a key driver of environmentally oriented behavior and innovation. The descriptive results reinforce this conclusion. Environmental vision and green intellectual stimulation were the strongest leadership dimensions, while green inspirational motivation was the weakest. This suggests that leaders in these firms are relatively successful in providing direction and encouraging green ideas, but still need to strengthen employees' emotional commitment and pride in sustainability-oriented work. Managerial implication. Companies should invest in green leadership development, especially in the inspirational dimension. Leaders need not only to communicate green goals, but also to build stronger employee pride, emotional ownership, and motivation around sustainability projects so that green innovation becomes more deeply embedded in organizational culture.

Overall, the results show that green innovation in Batam construction firms is driven mainly by internal organizational factors, especially intellectual capability, green transformational leadership, organizational climate, and corporate governance. At the same time, the non-significant moderation effects indicate that green transformational leadership functions more effectively as a direct predictor than as a strengthening mechanism in this model. Therefore, managerial efforts to improve green innovation should focus on strengthening each internal factor directly, especially employee capability, work climate, and the practical implementation of governance and leadership

2. Conclusion

This study concludes that green innovation in construction companies in Batam City is significantly influenced by organizational climate, corporate governance, intellectual capability, and green transformational leadership. Among these variables, intellectual capability emerged as the strongest predictor, followed by green transformational leadership, organizational climate, and corporate governance. These findings indicate that green innovation is primarily driven by internal organizational resources, especially employees' cognitive ability to analyze problems, make decisions, and adapt to new knowledge, as well as leadership that promotes environmental vision and green-oriented behavior. At the same time, the descriptive results show that green innovation itself remains relatively weak compared to the other constructs, indicating that environmentally friendly products, processes, technologies, and sustainable management practices still need to be strengthened in the sampled firms.

The study also found that green transformational leadership does not significantly moderate the relationships between organizational climate, corporate governance, and intellectual capability and green innovation. This means that green transformational leadership functions more effectively as a direct predictor rather than as a strengthening mechanism in this model. Overall, the findings suggest that efforts to improve green innovation in Batam construction firms should focus on strengthening employee intellectual capability, building a more supportive organizational climate, ensuring more consistent implementation of corporate governance, and enhancing green leadership practices. These results contribute to the literature by showing that in developing construction firms, green innovation depends more on the direct quality of internal organizational factors than on interaction effects among them.

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