JOURNAL OF INNOVATION AND TECHNOLOGY
eISSN:2805-5179 Vol. 2025, Issue 1, No.06

Theoretical Research on Multi-Stakeholders Collaborative Mechanism of Green Building

Yue Lan[1*], Leong Wai Yie[2]

[1]Liaoning Institute of Science and Engineering, Jinzhou 121000, China
[2]INTI International University, 71800 Nilai, Malaysia

[*]**Email:** 286751074@qq.com

Abstract

The push for sustainable development has accelerated the adoption of green building practices worldwide. It is an important trend to realize the "dual carbon" strategy and practice the sustainable development strategy. By analyzing the multi-stakeholders participation and interactive relationship in the whole process of green building construction, this study constructed an evolutionary strategic model based on the government, enterprises and users, this paper puts forward policy suggestions for the collaborative governance of multiple subjects in green buildings under the "dual carbon" goals, providing theoretical support and experience reference for accelerating the construction of a green, low-carbon and friendly built environment and achieving China's "dual carbon" goals.

Keywords

Sustainable cities and communities, Green building, Multi-stakeholders collaboration, Stakeholders, Mechanism research

Introduction

In recent years, due to global climate change and resource and environmental issues, green and low-carbon building development has become the common goal of governments around the world (Lu, 2019). As one of the major sources of energy consumption and carbon emissions, the green building transition is crucial (Leong, 2024a). However, the promotion of green building involves many stakeholders, including the policy support of the government, the technology application of enterprises and the market acceptance of users, and the synergy mechanism among the three directly affects the development effect of green building (He, 2023; Yang, 2024).

Theoretically, the promotion of green building is a typical multi-stakeholders strategic process. In this process, the government assumes the role of policy formulation and economic incentives, and its support is crucial for enterprises to adopt green technologies (Zhang, 2023). Enterprises need to find a balance between technology investment and market return. As the

Submission: 26 March 2025; **Acceptance:** 23 April 2025; **Available online:** June 2025

consumer, the purchase intention of the user not only depends on the economic cost but is also affected by environmental awareness and other factors (Chun, 2010). Therefore, it is of great significance to construct a strategic model, for the promotion of green building (Leong, 2024b).

Some researchers have discussed the development of green building from the perspective of incentive policy and market mechanism(Huang, 2025). However, most studies focus on a single stakeholder or static analysis (traditional approach), ignoring the dynamic interaction and evolution process between different stakeholders. Therefore, using the Multi-Stakeholders Collaborative Mechanism (MSCM) by constructing a dynamic strategic model of the government, enterprises and users to explore the collaborative mechanism in the promotion of green buildings (Cheng, 2025).

Through theoretical derivation and numerical simulation, this paper studies the evolution law of tripartite behavior and the characteristics of equilibrium point, and further analyzes the sensitivity of key parameters (such as government subsidies, user costs, etc.), to provide theoretical support for green building policy and design (Choo, 2018; Leong, 2009).

The innovations of this paper are mainly reflected in the following two aspects:

1.Combined with evolutionary strategic theory, this paper systematically describes the dynamic evolution of multi-stakeholders strategies in the process of green building promotion, which makes up for the shortcomings of static analysis in existing studies.

2.Through parameter sensitivity analysis, the influence of key policy tools (such as subsidies, costs, etc.) on consumer behavior is quantitatively revealed, providing decision-making basis for optimizing green building promotion policies.

Through this study, it is expected to provide theoretical reference and practical guidance for the government to formulate effective green building promotion policies, enterprises to adjust investment strategies reasonably, and consumers to enhance the acceptance of green buildings.

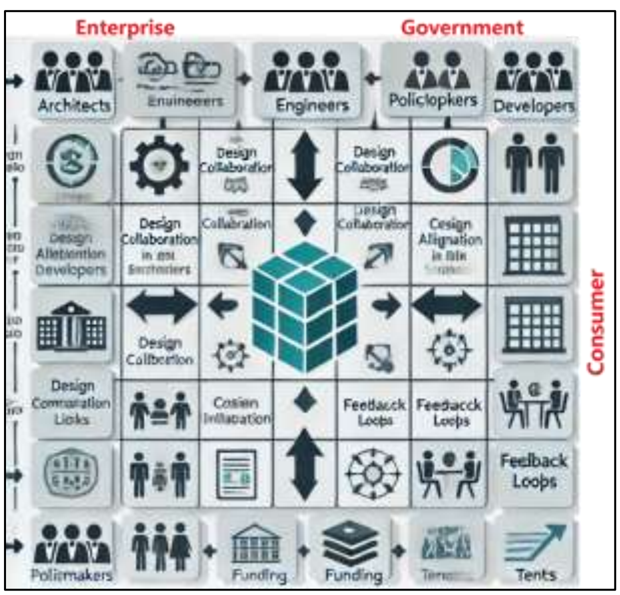

Figure 1: Interaction Matrix for Stakeholder Roles

Methodology

We adopt an evolutionary strategic model based on government, enterprise and consumer. The model will take the behavior choice in the development of green buildings, and analyze the dynamic interaction between the three stakeholders, Figure 1 (Wang, 2021).

Income matrix construction:

a. The government benefits from the cost of policy implementation brought by active intervention C_g, and the social benefits S_g of the popularization of green buildings.

b. Corporate benefits Additional cost of adopting green building technology C_e, profit from market demand P_e, government subsidies B.

c. Consumer revenue supports the environmental utility of green buildings E_u, and the additional expenditure for the purchase of green buildings C_u （Li Wanhong, Li Na.,2023).

Table1 Income matrix

Government/Enterprise/Consumer	E_1,U_1	E_1,U_2	E_2,U_1	E_2,U_2
G_1	$(S_g-C_g,P_e+B-C_e,E_u-C_u)$	$(S_g-C_g,P_e+B-C_e,-C_u)$	$(-C_g,P_e,E_u-C_u)$	$(-C_g,P_e,E_u-C_u)$
G_2	$(0,P_e-C_e,E_u-C_u)$	$(0,P_e-C_e,-C_u)$	$(0,P_e,E_u-C_u)$	$(0,P_e,-C_u)$

Dynamic evolution equation: Let the policy choices of the three parties be x, y, and z respectively:

- The average income of each entity
  - Average revenue of the government,enterprises and users.

$$\pi_{\mathrm{g}}=x\times[(1-y)\times(-\mathrm{C})+y\times(z\times(S_g-C_g))]+(1-x)\times G \qquad (1)$$

$$\pi_{\mathrm{e}}=y\times[z\times(P_e+B-C_e)+(1-z)\times(P_{\mathrm{e}}-C_e)]+(1-y)\times P_{\mathrm{e}} \qquad (2)$$

$$\pi_{\mathrm{u}}=z\times[x\times(y\times(E_u-C)+(1-y)\times E_u]+(1-z)\times(-C_u) \qquad (3)$$

- (2) Replicate the dynamic equation
  - Government evolution equation,Enterprise evolution equation,Consumer evolution equation

$$\dot{x}=x\times(1-x)\times(\pi_{\mathrm{g}}-\bar{\pi}_{\mathrm{g}}) \qquad (4)$$

$$\bar{\pi}_{\mathrm{g}}=x\times\pi_{\mathrm{g}}+(1-x)\times G \qquad (5)$$

$$\dot{y}=y\times(\pi_{\mathrm{e}}-\bar{\pi}_{\mathrm{e}}) \qquad (6)$$

$$\bar{\pi}_{\mathrm{e}}=y\times\pi_{\mathrm{e}}+(1-y)\times P_e \qquad (7)$$

$$\dot{z}=z\times(\pi_{\mathrm{u}}-\bar{\pi}_{\mathrm{u}}) \qquad (8)$$

$$\bar{\pi}_u = z \times \pi_u + (1-z) \times (-C_u) \quad (9)$$

- 4.Model solving and analysis

a. Equilibrium point solving

By setting , $\dot{y} = 0$, $\dot{z} = 0$, the equilibrium point of the evolution system is obtained, and the stability strategies of the three parties under different conditions are analyzed.

b. Stability analysis

c. Parameter sensitivity analysis

Suppose C_u decreases: user revenue π_e increases, which promotes z^* to increase; By reducing the cost of users' willingness to pay (such as tax incentives), user acceptance of green buildings can be promoted (Zhou Shenbei, Li Ying, & Li Yisheng.,2024）.

Results and Discussion

A tripartite evolutionary strategic model of construction enterprises, government and consumers is constructed to analyze the influence mechanism of their evolutionary strategies on green buildings, and the evolutionary path of low-carbon transformation of construction enterprises is analyzed by simulation. Figure 1 compares the percentage reduction in carbon emissions achieved using the Multi-Stakeholders Collaborative Mechanism (MSCM) versus the traditional approach.

The following conclusions can be drawn from the analysis:

a. Government: With the positive response of enterprises and users, the government is more inclined to support green buildings, indicating the long-term feasibility of policy stimulus.

b. Enterprises: Government subsidies B and user support z are the main factors driving enterprises to adopt green building technology.

c. Consumers: Consumers' support strategies are mainly affected by green building cost C_u and environmental utility E_u.

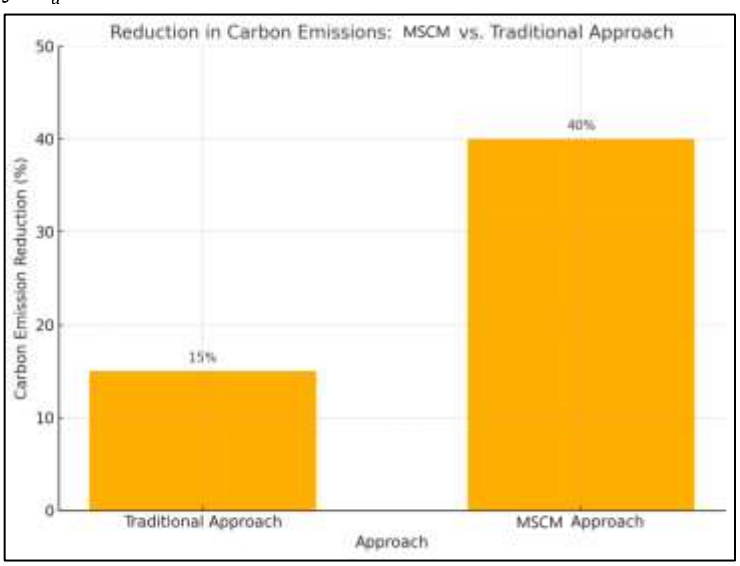

Figure 2: Reduction in Carbon Emissions with MSCM vs. Traditional Approach.

2. Policy suggestions

a. Government intervention: moderately increase subsidies to reduce the cost of green building for enterprises.

b. Market incentives: Improve consumers' purchase intention through green building signs.

c. Multi-stakeholders collaboration: establish an information sharing platform for governments, enterprises and consumers to improve collaborative efficiency.

3. Future research direction

a. Dynamic parameter adjustment: Study the dynamic change rules of subsidies, technical costs and users' willingness to pay in different policy stages.

b. Social benefit assessment: Quantitative analysis of the long-term contribution of green buildings to the environment and economy, and research on more complex synergistic mechanisms (Table 2) (Wang, 2025).

c. Multi-stakeholders expansion model: including the influence factors of financial planning and non-governmental organizations to study more complex collaborative mechanisms (Leong, 2024c).

d. Empirical analysis: Based on the actual data, the rationality of the model hypothesis is verified, and targeted suggestions are made on the promotion policies of green buildings in different regions.

e. Under the "dual carbon" goals, achieving collaborative governance among multiple stakeholders in green buildings requires, on the one hand, further integrating the concept of collaborative governance with regional economic development, and on the other hand, creating a favorable policy ecosystem for the development of green buildings, enhancing policy enforcement, proceeding step by step, and improving the effectiveness of collaborative governance among multiple stakeholders in green buildings to promote the sustainable development of the construction industry.

Table 2: Cost-Benefit Analysis of Collaborative Mechanism

Parameter	Traditional Approach	MSCM Approach	Improvement (%)
Energy Efficiency	65%	80%	+15%
Material Cost	\$500,000	\$450,000	-10%

Acknowledgements

The authors would like to express their sincere gratitude to all individuals and institutions who contributed to the completion of this research. Special thanks are due to the editorial board and anonymous reviewers for their insightful comments and suggestions that significantly improved the quality of the manuscript.

References

Cheng, Z. (2025). Optimization path of multi-subject participation in the renovation of old residential areas from the perspective of collaborative governance. Shanghai Real Estate, (04), 10–13. https://doi.org/10.13997/j.cnki.cn31-1188/f.2025.04.004

Choo, K. H., Rozana, Z., Azlan, A., & Leong, W. Y. (2018). Various techniques on retrofitting for earthquake hazard mitigation. International Journal of Engineering & Technology, 7(3.36), 167. https://doi.org/10.14419/ijet.v7i3.36.29101

Chun, W. X., & Leong, W. Y. (2010). Composite defects diagnosis using parameter optimization based support vector machine. In 2010 5th IEEE Conference on Industrial Electronics and Applications (pp. 2300–2305). IEEE. https://doi.org/10.1109/ICIEA.2010.5515481

He, Y., Guo, H., Su, C., Wang, M., & Jin, Z. (2023). Research framework of multi-stakeholders dynamic coupling mechanism and collaborative strategy for green transformation of existing buildings. Fly Ash Comprehensive Utilization, 37(2).

Huang, J., Guo, C., Feng, L., & Qi, J. (2025). Research on the development trend, characteristics and mission of practical education in higher vocational colleges from the perspective of synergy theory. Modern Vocational Education, (13), 41–44.

Leong, W. Y., Leong, Y. Z., & Leong, W. S. (2024a). Green communication systems: Towards sustainable networking. In The 5th International Conference on Information Science, Parallel and Distributed Systems (ISPDS 2024). China. https://doi.org/10.1109/ISPDS62779.2024.10667574

Leong, W. Y., Leong, Y. Z., & Leong, W. S. (2024b). Energy management policy and strategies in ASEAN. Advances in Science, Technology and Engineering Systems Journal, 9(4), 102–109. http://dx.doi.org/10.25046/aj090411

Leong, W. Y., Leong, Y. Z., & Leong, W. S. (2024c). Energy demand forecasting and optimization. In International Conference on Logistics and Industrial Engineering (ICLIE). Ho Chi Minh City. https://doi.org/10.1109/ICLIE61478.2024.11015422

Leong, W. Y., & Liu, W. (2009). Structural health monitoring: Subsurface defects detection. In 2009 35th Annual Conference of IEEE Industrial Electronics (pp. 4326–4330). IEEE. http://dx.doi.org/10.1109/IECON.2009.5414919

Li, W., & Li, N. (2023). Stochastic evolutionary game of multi-stakeholders collaborative innovation in green intelligent manufacturing ecosystem. Operations Research and Management, 32(6), 111. http://www.jorms.net/EN/10.12005/orms.2023.0190

Lu, J., Ouyang, H., & Han, L. (2019). The evolution mechanism of low-carbon transformation in construction enterprises under multi-stakeholders interactive game. Journal of Beijing Institute of Technology (Social Sciences Edition), (1), 17–26.

Wang, Y., Cao, N., & Cui, W. (2025). Research on the formation mechanism of collaborative behaviors of promoters of prefabricated building. Journal of Engineering Management, (02), 31–36. https://doi.org/10.13991/j.cnki.jem.2025.02.006

Wang, Y., & Guo, F. (2021). Construction of multi-stakeholders coordination mechanism in renewal of old urban residential areas. Journal of Urban Planning, 3, 50–57.

Yang, F., & Leong, W. Y. (2024). BIM risk evaluation for comprehensive management corridor projects. In Industry 5.0: Design, standards, techniques and applications for manufacturing. The Institution of Engineering and Technology (IET), UK. https://doi.org/10.1049/PBME026E_ch14

Zhang, Z., Li, R., & Zhao, B. (2023). Research on profit distribution mechanism of collaborative innovation body with multi-stakeholders participation. Science and Technology Progress and Countermeasures, 33(20), 25–29. https://www.kjjb.org/EN/10.6049/kjjbydc.2016040520

Zhou, S., Li, Y., & Li, Y. (2024). Analysis of supply and demand of green building based on foreview theory. Journal of Engineering Management/Gongcheng Guanli Xuebao, 38(2).