Journal Homepage: www.ijrpr.com ISSN: 3049-0103 (Online)

International Journal of Advance Research Publication and Reviews

Vol 02, Issue 07, pp 192-204, July 2025

Elucidating the Role of Green Human, Structural, and Relational Capitals in Explaining the Relationship Between Strategic Green Innovation Orientation and Competitive Advantage in Manufacturing Industries

Mostafa Farhad Kiaei

Master of Business Administration, Payam Noor University, Tehran, Iran.
DOI : https://doi.org/10.55248/gengpi.6.0725.2578

ABSTRACT

In recent decades, environmental issues and societal expectations, as well as regulatory pressures for sustainable development, have increasingly compelled companies to reconsider their business strategies and innovations. Especially within manufacturing industries, the consequences of environmental impacts and corporate social responsibility messages have played a pivotal role in shaping competitive advantage. In this context, green innovation—serving as a transformative strategy—not only reduces the negative environmental effects of manufacturing activities but also enhances organizational competitive capabilities. This study aims to examine the role of strategic green innovation orientation and green human, structural, and relational capitals on the competitive advantage of small and medium-sized enterprises (SMEs). Methodologically, this research is descriptive-correlational in nature and applied in purpose. The target population comprises managers and experts from manufacturing firms located in the industrial towns of Qazvin province. The sample size was determined to be 165, using Cochran's formula, with simple random sampling employed. Data were collected through library and field studies, with standard questionnaires utilized in the field section. Instrument validity was assessed via face validity and construct validity (using convergent and discriminant methods), and reliability was measured using Cronbach's alpha coefficient. Data were analyzed using structural equation modeling (SEM) and SPSS version 19 and Smart PLS software. The findings confirmed all the research hypotheses. Overall, the results indicate that strategic orientation toward green innovation, as well as green human, structural, and relational capitals, have significant and positive effects on the competitive advantage of SMEs in Qazvin province.

Keywords: *Strategic green innovation orientation, green capitals, competitive advantage, manufacturing industries*

1. Introduction

Rapid environmental changes, growing legal pressures, and escalating expectations from local and global communities have pushed manufacturing organizations to rethink their traditional business models and strategies (Chen et al., 2022; Fallah Shams et al., 2021). According to the literature in strategic management and corporate social responsibility, traditional approaches are no longer sufficient to meet market and environmental needs. Companies are thus compelled to embed green innovation at the core of their strategies (Suriankitkao & Oury, 2021). Beyond mitigating environmental consequences, green innovation contributes to creating new value and enhancing firms' competitive advantages—advantages that, in today's dynamic markets, can no longer be created or sustained through traditional resources alone (Chang & Hsu, 2020).

Based on the intellectual capital model, the fundamental capabilities of any organization are rooted in three components: human capital, structural capital, and relational capital. In the emerging approach of "green intellectual capital," these components acquire a new essence oriented toward supporting environmental goals and green innovation (Secundo et al., 2021). Green human capital refers to employees' specialist knowledge, skills, attitudes, and eco-friendly behaviors; green structural capital encompasses infrastructures, policies, technologies, and processes that enable green innovation; and green relational capital signifies business partners, social networks, and stakeholder relationships founded on environmental values (Yang et al., 2020).

However, a review of the literature demonstrates that most previous research has primarily examined the overall effect of intellectual capital or its individual dimensions on performance or innovation (Bontis et al., 2021), or has considered green innovation solely as a technical process (Baumgartner, 2022). Few studies have analyzed the combined and simultaneous roles of all three components of green intellectual capital together with strategic green innovation orientation in fostering competitive advantage—especially at the SME level in developing countries like Iran (Farahani et al., 2020; Li et al., 2022). This gap persists even though recent literature underscores the need for an integrated focus on human, structural, and relational dimensions in the success of environmental innovations, maintenance of competitive advantage, and responsiveness to market and policy requirements (Jahanshahi et al., 2021). Moreover, Iranian SMEs, compared to their global counterparts, face greater vulnerability to green innovation efforts due to resource constraints, structural immaturity, and weak relational networks (Kazemi et al., 2023).

To date, no systematic study within the country has examined the combined effect of strategic green innovation orientation and the trio of green human, structural, and relational capitals on competitive advantage in Iran's manufacturing sector—especially in Qazvin province—despite growing environmental challenges and policy mandates making such an analysis all the more necessary (Fadaei & Soltani, 2023). Accordingly, the present research seeks to address this theoretical gap by integrating the green intellectual capital framework with strategic green innovation orientation, exploring how various dimensions of green capital (human, structural, relational) contribute to the development and enhancement of competitive advantage among SMEs in Qazvin's manufacturing sector. The findings of this research can be of considerable significance for both theoretical advancement in the literature and the formulation of practical policies and management strategies for firms.

2. Theoretical Foundations and Literature Review

In recent decades, increasing attention has been devoted to environmental sustainability and corporate social responsibility, particularly under the influence of institutional pressures, evolving customer expectations, and governmental policy requirements (Li et al., 2023). Competitive advantage is no longer solely reliant on traditional factors such as cost, quality, or market access, but is now shaped by value creation through intangible resources like knowledge, innovation, and intellectual capital (Andreeva et al., 2022). In this context, the concept of green innovation emerges as a key strategy for meeting the demands of sustainable development. Green innovation is not only oriented toward enhancing environmentally-friendly technologies but also encompasses a transformative view of business processes, products, and services, ultimately leading to reduced environmental impacts, enhanced competitive advantage, and sustainable performance (Yu et al., 2023; De Stroe et al., 2022).

Within this framework, green intellectual capital—comprising three critical dimensions—plays a foundational role. Green human capital represents employees' knowledge, skills, beliefs, and commitment to promoting environmental sustainability within the organization. Numerous studies, such as Wang et al. (2024), suggest that green human capital increases organizational capabilities for developing green products and processes, thereby improving both environmental and economic performance. Green structural capital refers to learning structures and processes, information systems, organizational culture, and policies that support environmental activities. This type of capital facilitates the creation and transfer of green knowledge within the organization, making the successful implementation of green innovations possible (Owen et al., 2024). Green relational capital centers on relationships with stakeholders (customers, suppliers, governmental and social institutions) based on environmental values; the findings of Yousef et al. (2023) indicate that green relational capital provides a suitable platform for adopting green technologies and expanding markets for sustainable products.

A review of international studies shows that the integration of strategic green innovation orientation with various dimensions of green intellectual capital leads to improved competitive advantage for manufacturing companies. Lin and Li (2022), in their study of East Asian electronics firms, asserted that green innovation strategies are most effective when supported by green human, structural, and relational capitals. Similarly, research by Chen et al. (2022) in China's industrial sector highlights the simultaneous importance of both variables in enhancing competitive advantage and creating shared value for the organization and environmentally-oriented society. Within Iran, studies by Fallah Shams et al. (2021), Kazemi et al. (2023), and Asadifar & Ghasemi (2022) have emphasized the unique role of developing green intellectual capital in Iranian SMEs and its positive effect on environmental performance and competitiveness. Nonetheless, many prior studies have focused on a single dimension of green intellectual capital or solely on green innovation, while the cumulative and interactive effects of these factors—particularly in Iranian industrial settings and with contextually appropriate samples—have received far less attention (Fadaei & Soltani, 2023; Faraji et al., 2023).

A comprehensive review of the literature indicates that a deeper understanding of the interaction between strategic green innovation orientation and green human, structural, and relational capitals for competitive advantage can inform policy support, guide organizational training programs, foster a learning culture, and strengthen environmental responsibility in SMEs. Given the aforementioned research gap and the importance of manufacturing industries in Qazvin Province as one of Iran's industrial hubs, this study is an attempt to address this void and provide novel practical and theoretical insights in this specialized field.

3. Conceptual Model and Research Hypotheses

Within the conceptual framework developed for this research, strategic green innovation orientation has been defined as the independent (predictor) variable that directly affects all three components of green intellectual capital—namely, green human capital, green structural capital, and green relational capital. These three components act as mediating variables, transmitting the effect of strategic green innovation orientation onto competitive advantage (Owen et al., 2024). Additionally, the model posits not only indirect effects through the green capitals but also a direct relationship between strategic green innovation orientation and competitive advantage, underlining the simultaneous significance of strategic intervention and green knowledge assets for building and sustaining competitive advantage in manufacturing firms. The theoretical logic of the model is grounded in the resource-based view (RBV) and the intellectual capital perspective—implying that organizations, by developing a strategic orientation toward green innovation, lay the foundation for enhanced knowledge, skills, organizational systems, and relationships based on environmental values. This, in turn, boosts their ability to respond rapidly to environmental changes and exploit market opportunities, ultimately improving competitive advantage (Wang et al., 2024). Accordingly, the conceptual model and research hypotheses are as follows:

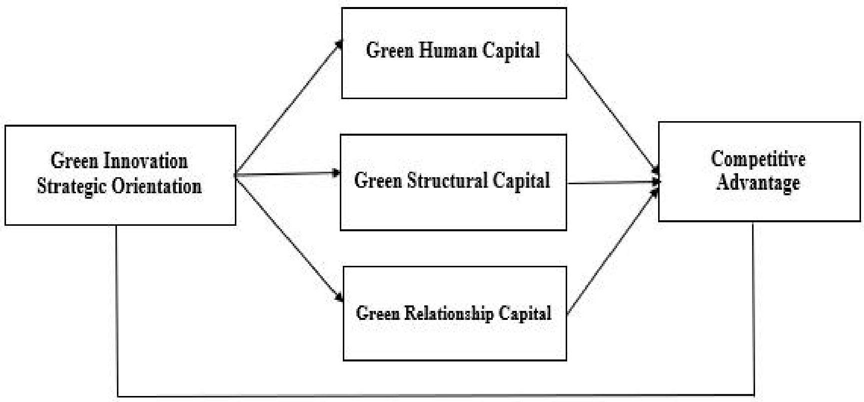

Figure 1. Conceptual Model of the Research

Research Hypotheses

Hypothesis 1: Strategic green innovation orientation has a significant direct effect on firms' competitive advantage.

Hypothesis 2: Strategic green innovation orientation has a significant effect on firms' green human capital.

Hypothesis 3: Strategic green innovation orientation has a significant effect on firms' green structural capital.

Hypothesis 4: Strategic green innovation orientation has a significant effect on firms' green relational capital.

Hypothesis 5: Green human capital has a significant effect on firms' competitive advantage.

Hypothesis 6: Green structural capital has a significant effect on firms' competitive advantage.

Hypothesis 7: Green relational capital has a significant effect on firms' competitive advantage.

Hypothesis 8: Strategic green innovation orientation has a significant effect on firms' competitive advantage through the mediating role of green human capital.

Hypothesis 9: Strategic green innovation orientation has a significant effect on firms' competitive advantage through the mediating role of green structural capital.

Hypothesis 10: Strategic green innovation orientation has a significant effect on firms' competitive advantage through the mediating role of green relational capital.

3-1. Research Methodology

The present study is an applied esearch, grounded in the positivist paradigm, employing a quantitative approach with a survey-based and correlational strategy in a cross-sectional design. The statistical population comprises managers and experts from manufacturing firms located in the industrial towns of Qazvin province. The sample size was determined to be 165 individuals based on Cochran's formula, using simple random sampling. To develop the theoretical foundations, a library method and document analysis were used; for collecting field data, a standard questionnaire based on the Likert scale was employed. For ensuring instrument validity, standard questionnaires from Hsu et al. (2016), Chang et al. (2011), and Chen (2008) were adopted. To assess the reliability of the questionnaire, given the ordinal measurement scale with five ranks, Cronbach's alpha coefficient was applied. For the analysis of statistical data and the testing of research hypotheses, structural equation modeling and path analysis using Partial Least Squares (PLS) approach, as well as SPSS 19 and SmartPLS 3 software, were employed.

Table 1- Demographic Characteristics of Respondents

Variable	**Category**	**Frequency (n)**	**Relative Frequency (%)**
Age	Under 25 years	17	10%
	25–35 years	65	40%
	35–45 years	43	26%
	45–55 years	30	18%
	Over 55 years	10	6%
Education	Bachelor's degree	101	61%

	Master’s degree	48	29%
	Doctorate (PhD)	16	10%
Work Experience	Less than 5 years	23	14%
	5–10 years	64	39%
	10–20 years	56	34%
	20–30 years	22	13%
Gender	Male	157	95%
	Female	8	5%

4. Assessment of Data Normality Using the Kolmogorov–Smirnov (K-S) Test

In studies conducted at the nominal and ordinal scales, non-parametric tests must be used for data analysis. In other words, to determine influential factors or to test the normality of data distribution, the Kolmogorov–Smirnov test can be employed. The K-S test examines the null hypothesis that the observed data follow a specific distribution (with certain parameters), which is assumed based on prior evidence or theoretical considerations. In this test, the distribution of the observations is compared to the specified distribution.

In the present study, the Kolmogorov–Smirnov goodness-of-fit test was used to assess the normality of the data. The hypotheses examined in this test are as follows:

- **H0**: There is a difference between the observed and expected frequencies (the distribution of observations is not normal).
- **H1**: There is no difference between the observed and expected frequencies (the distribution of observations is normal).

The results of this test are presented in Table 2.

Table 2. Kolmogorov-Smirnov Test Results

Variable	**Mean**	**Standard Deviation**	**Significance (p-value)**	**Z Statistic**	**Test Result**
Strategic Green Innovation Orientation	4.325	0.662	0.129	1.246	Null hypothesis confirmed
Green Human Capital	4.222	0.529	0.067	1.239	Null hypothesis confirmed
Green Structural Capital	3.123	0.597	0.072	1.312	Null hypothesis confirmed
Green Relational Capital	4.219	0.638	0.113	1.562	Null hypothesis confirmed

Competitive Advantage	3.925	0.642	0.061	1.184	Null hypothesis confirmed

According to Table 2, the significance values (Sig) for the data, as well as the Z statistic falling within the ±1.96 range at a 95% confidence level and a 5% margin of error, indicate that there is a difference between the observed and expected frequencies. Therefore, the assumption of normality is not met, and it is appropriate to use non-parametric statistical tests.

4-1. Reliability and Validity of the Measurement Model

In this study, Cronbach's alpha was used to assess the reliability of the research instrument. A Cronbach's alpha coefficient above 0.6 is generally considered acceptable for reliability, and some sources suggest that a value above 0.7 indicates good reliability.

The composite reliability criterion, introduced by Werts et al. (1974), is superior to Cronbach's alpha because it calculates construct reliability based not in absolute terms but based on the correlations among the items. The following table presents the Dillon-Goldstein coefficients (composite reliability) for the constructs. As seen in the table, all values are above 0.7, indicating that the model has good composite reliability.

Convergent validity refers to the extent to which two instruments used to measure a concept are highly correlated. To assess convergent validity, Fornell and Larcker (1981) proposed the average variance extracted (AVE) as a criterion for convergent validity. An AVE value of at least 0.5 suggests sufficient convergent validity. As shown in the AVE table, all AVE values for the research variables are greater than 0.5.

Discriminant validity means that the items or indicators related to one construct should measure only that construct. In PLS analysis, according to Fornell and Larcker (1981), the square root of the AVE for a construct should be greater than its correlation with other constructs in the model.

Table 3. Reliability and Validity Measures of the Research Constructs

Variable	Cronbach's Alpha	Composite Reliability	AVE	Convergent Validity (√AVE)
Strategic Green Innovation Orientation	0.844	0.884	0.563	0.750
Green Human Capital	0.780	0.858	0.602	0.776
Green Relational Capital	0.853	0.900	0.693	0.833
Green Structural Capital	0.906	0.923	0.573	0.757
Competitive Advantage	0.864	0.898	0.597	0.773

As shown in the variable correlation table, the square roots of the AVE values, which are placed on the diagonal of the correlation matrix, are greater than the correlations of each variable with other variables. This indicates that the model has satisfactory discriminant validity.

Table 4. Correlation Matrix of Variables

Variable	Strategic Green Innovation Orientation	Green Human Capital	Green Relational Capital	Green Structural Capital	Competitive Advantage
Strategic Green Innovation Orientation	0.750				
Green Human Capital	0.540	0.776			
Green Relational Capital	0.450	0.570	0.833		
Green Structural Capital	0.387	0.512	0.320	0.757	
Competitive Advantage	0.523	0.428	0.369	0.441	0.773

4-2. Measurement Model Quality Assessment or Communality Index

This index is calculated using the communality index with cross-validity. It essentially evaluates the ability of the path model to predict the observed variables based on the values of their corresponding latent constructs. Since all values are positive, the model demonstrates an acceptable level of quality.

Table 5. Measurement Model Quality Assessment or Communality Index

Variable	**1-SSE/SST (Communality Index)**
Strategic Green Innovation Orientation	0.379
Green Human Capital	0.340
Green Relational Capital	0.462
Green Structural Capital	0.441
Competitive Advantage	0.417

Model Fit in PLS

One of the main differences between LISREL and PLS is the inadequacy of traditional fit indices for models estimated using PLS. To address this, Tenenhaus et al. (2005) introduced the overall goodness-of-fit (GOF) index for evaluating model fit in PLS analysis. The overall GOF criterion can be calculated as the geometric mean of the average communality and the average R^2 value:

content_copy

$$GOF = \sqrt{[\text{Average (Communality)} \times \text{Average } (R^2)]}$$

This index functions similarly to the fit indices in LISREL and ranges from zero to one, with values closer to one indicating better model quality.

Table 6. Communality Test Results

Variable	Communality
Strategic Green Innovation Orientation	0.887
Green Human Capital	0.850
Green Relational Capital	0.882
Green Structural Capital	0.900
Competitive Advantage	0.894

The average value of the communality index is calculated using the following formula:

Communality = (1/N) × ΣCommunality

The communality value is 0.882. The R^2 value is 0.592, which can be observed in the standardized path coefficients output. According to the GOF calculation formula, we have:

GOF = $\sqrt{(0.883 \times 0.592)} = 0.556$

The GOF index ranges between zero and one. Wetzels et al. (2005) identified values of 0.01, 0.25, and 0.35 as indicating weak, moderate, and strong GOF, respectively. Given the obtained value of 0.556, the research model demonstrates a strong overall fit.

4-3. Evaluation of Reflective Measurement Models

The path coefficient indicates the existence of a linear causal relationship as well as the strength and direction of this relationship between two latent variables. In fact, it is equivalent to the regression coefficient in standardized form, similar to what is observed in simple and multiple regression models. This coefficient ranges from -1 to +1, where a value of zero shows no linear causal relationship between two latent variables. Path coefficients demonstrate what percentage of the variance in the dependent variable is explained by the independent variables. The coefficient of determination (R^2) is, in fact, the most important indicator in studies utilizing structural equation modeling. In this study, the factor loadings for the measurement model of Strategic Green Innovation Orientation, Green Human Capital, Green Structural Capital, Green Relational Capital, and Competitive Advantage were calculated using the PLS software. All coefficients were significant at the 95% confidence level. Therefore, the results obtained from the factor loadings confirm the high validity of the model.

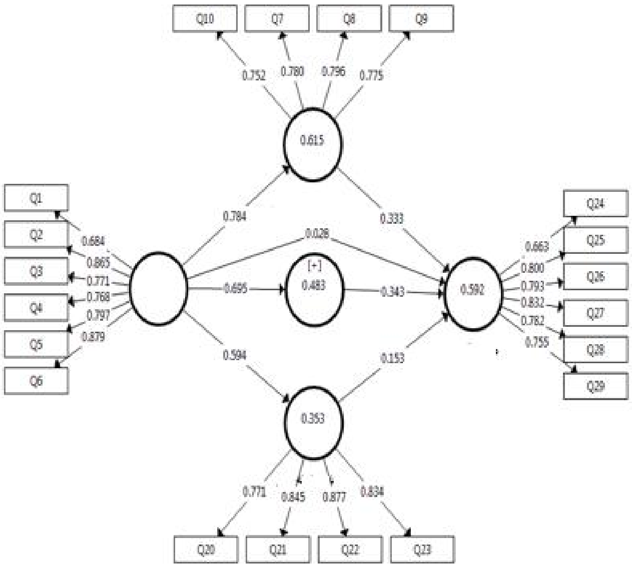

Figure – Research Model with Standardized Path Coefficient Estimates

The following diagram (Significance of Hypotheses Coefficients) presents the research models showing the significance of coefficients (t-values). This model tests all measurement equations (factor loadings) and structural equations (path coefficients) using the t statistic. Based on the hypotheses formulated in this study, according to this model, a path coefficient or factor loading is considered significant at the 95% confidence level if the t-value falls outside the interval (-1.96 to +1.96). If the t-value lies within this interval, the corresponding factor loading or path coefficient is not significant. At the 99% confidence level, significance is established if the t-value falls outside the interval (-2.58 to +2.58). According to the obtained t-test results, all factor loadings were significant at the 95% confidence level and made a meaningful contribution to the measurement of their respective constructs.

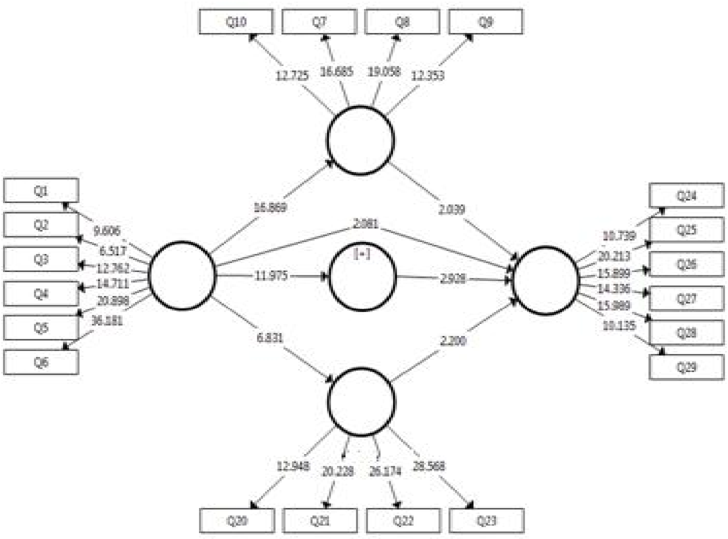

Figure 2 – Significance Coefficients of Hypotheses in the Model

4-4. Evaluation of Formative Measurement Models

One method for evaluating formative models is through the coefficient of determination (R^2). The R^2 value assesses the proportion of variance in a dependent variable that is explained by the independent variable(s). For an independent variable, this value is zero, while for a dependent variable, it is greater than zero. The higher this value, the greater the explanatory power of the independent variables on the dependent variable.

Based on the coefficient of determination for the model, it can be stated that Strategic Green Innovation Orientation, Green Human Capital, Green Structural Capital, and Green Relational Capital together explain 0.592 of the variance in the Competitive Advantage variable. Researchers have proposed benchmark values for R^2: 0.19 (weak), 0.33 (moderate), and 0.67 (strong). Accordingly, it can be concluded that the model demonstrates satisfactory predictive capability. The remaining value represents prediction error and may include the effects of other factors influencing competitive advantage.

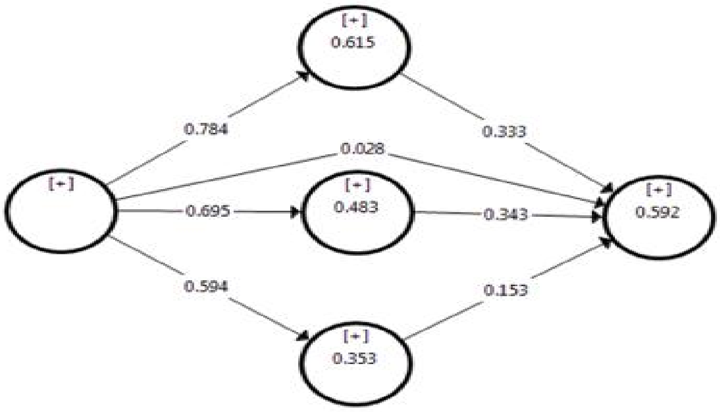

Figure 3 – Evaluation of Formative Measurement Models

4-5. Overall Results of Research Hypotheses

The overall results of all the research hypotheses are presented in the following table:

Table 7. Overall Results of Research Hypotheses

Hypothesis	Standardized Path Coefficient (β)	t-value	Significance	Hypothesis Status
Strategic Green Innovation Orientation → Competitive Advantage	0.028	2.081	Sig < 0.05	Not Rejected
Strategic Green Innovation Orientation → Green Human Capital	0.784	16.869	Sig < 0.05	Not Rejected
Strategic Green Innovation Orientation → Green Structural Capital	0.695	11.975	Sig < 0.05	Not Rejected

Strategic Green Innovation Orientation → Green Relational Capital	0.594	6.831	Sig < 0.05	Not Rejected
Green Human Capital → Competitive Advantage	0.333	2.039	Sig < 0.05	Not Rejected
Green Structural Capital → Competitive Advantage	0.343	2.928	Sig < 0.05	Not Rejected
Green Relational Capital → Competitive Advantage	0.153	2.200	Sig < 0.05	Not Rejected
Strategic Green Innovation Orientation → Competitive Advantage (Mediated by Green Human Capital)	0.261	9.723	Sig < 0.05	Not Rejected
Strategic Green Innovation Orientation → Competitive Advantage (Mediated by Green Structural Capital)	0.238	7.315	Sig < 0.05	Not Rejected
Strategic Green Innovation Orientation → Competitive Advantage (Mediated by Green Relational Capital)	0.091	4.552	Sig < 0.05	Not Rejected

5. Discussion and Conclusion

The results of hypothesis testing in the present study demonstrate that strategic green innovation orientation has a direct and significant impact on the competitive advantage of manufacturing firms. In other words, strengthening green innovation strategies leads to an increase in competitive advantage. This finding is consistent with the studies of Dong et al. (2022), Sharma et al. (2020), and Salido et al. (2019).

Furthermore, strategic green innovation orientation was found to have a positive and significant effect on green human capital, green structural capital, and green relational capital. In other words, the adoption of green strategies enhances organizational and knowledge-based capital within firms—a point also emphasized by the research of Pham et al. (2019), Liu et al. (2017), Huang et al. (2020), Papadas et al. (2019), and Hsu et al. (2016). The results also indicate that all three components of green intellectual capital (human, structural, and relational) have a positive and significant effect on competitive advantage. This highlights that enhancing human capacities, developing structures, and strengthening organizational relationships based on environmental values play a crucial role in improving firms' competitiveness (in line with the findings of Sadegh et al., Liu et al., Xue et al., Dong et al., Pham et al., and Chang et al.).

In addition to the direct effects, the results showed that strategic green innovation orientation also indirectly affects competitive advantage through the mediating roles of green human capital, green structural capital, and green relational capital. In other words, strengthening green innovation orientation—through the mediation of green capital components—can have a greater impact on the competitiveness of manufacturing companies. These results are consistent with studies such as Dong et al. (2022), Papadas et al. (2020), Ahmad et al. (2021), Yousaf et al. (2020), and Haldorai et al. (2021).

Overall, the findings of this study underscore the necessity of simultaneously considering green innovation strategies and knowledge-based green capital to enhance competitive advantage, particularly in small and medium-sized manufacturing enterprises. These results provide both theoretical and practical foundations for managerial decision-making in this domain. Accordingly, to improve the competitive advantage of small and medium-sized manufacturing firms, it is recommended that managers develop and implement green innovation strategies to orient the organization's vision and strategy towards the acceptance and promotion of environmental innovations. This can be achieved through defining green missions, setting objectives to reduce pollutants, producing environmentally friendly products, and improving manufacturing processes; supportive policies can also strengthen the company's sustainable competitive foundations. Additionally, targeted investment in developing green human capital—through continuous sustainability training, increasing employees' environmental knowledge, and updating green skills—plays a significant role in the effectiveness of green innovation, especially as motivational programs and encouragement for employee participation in green projects will further develop human capital.

From a structural perspective, strengthening organizational structures and green processes—including the revision of knowledge management systems, adoption of modern information technologies, and developing green-oriented internal guidelines—are essential. The adoption of international standards such as ISO 14001 and the development of knowledge-related communication infrastructures will reinforce stability and continuity in the path of green innovation. Moreover, expanding green relational capital through the development of inter-organizational collaborations, effective engagement with suppliers, customers, and other stakeholders based on environmental values, active membership in green networks and consortia, and entering sustainable cooperation contracts are essential and play a key role in the flourishing of relational capital.

Finally, adopting an integrated and systemic approach to green innovation orientation and organizational green capitals not only optimizes resources but also facilitates the path towards sustainable competitiveness. The use of green performance indicators and periodic evaluations can enhance the effectiveness of this approach. Furthermore, supporting a learning and green organizational culture—through the promotion of environmental values, role-modeling by managers, holding green festivals and events, and fostering an open and flexible environment for new ideas—will lay the groundwork for dynamism, innovation, and continuous organizational learning in line with sustainable development goals.

References

Andreeva, T., & Marr, B. (2022). Perspectives on intellectual capital and green innovation: Evidence from manufacturing SMEs. *Journal of Cleaner Production*, 360, 132-145.

Awan, U., Sroufe, R., & Shahbaz, M. (2024). The interplay between green intellectual capital and sustainable competitive advantage in SMEs. *Business Strategy and the Environment*, 33(1), 54-72.

Chen, Y. S., Lin, M. J., & Chang, C. H. (2022). The influence of green innovation and green intellectual capital on competitive advantage. *Industrial Management & Data Systems*, 122(7), 1540-1559.

De Steur, H., Bouzembrak, Y., & Verbeke, W. (2022). Green innovation adoption in food manufacturing SMEs: A cross-country study. *Food Policy*, 109, 102287

FaLah Shams, R., Fadaei, M., & Soltani, H. (2021). The effect of green intellectual capital on competitive performance of manufacturing companies. *Industrial Management Quarterly*, 13(4), 109-124.

Faraji, A., Fadaei, M., & Soltani, H. (2023). The role of green innovation orientation in enhancing competitiveness of Qazvin industries: A structural modeling approach. *Green Business Quarterly*, 7(1), 21-38

Farahani, R., Akbari, A., & Jafari, S. (2020). The relationship between green intellectual capital and competitive advantage in industrial companies. *Journal of Industrial Management*, 12(3), 57-72.

Fadaei, F., & Soltani, M. (2023). The impact of green innovation orientation on competitive performance of manufacturing firms. *Environmental Management Quarterly*, 15(2), 41-59.

Kazemi, F., Asadifar, R., & Ghasemi, B. (2023). Green human capital and organizational learning opportunities in the development of green innovation in Iranian SMEs. *Journal of Sustainable Development Management*, 9(2), 45-62.

Li, D., Zhao, Y., & Ning, L. (2023). Institutional pressures, green innovation, and firm performance: Evidence from China's manufacturing. Sustainable Production and Consumption, 37, 80–94.

Wang, M., Hao, H., & Zhu, J. (2024). Employee green intellectual capital and enterprise innovation: Moderating role of environmental leadership. Journal of Business Research, 174, 114403.

Yousaf, Z., Shahzad, F., & Farrukh, M. (2023). Exploring green relational capital's role in competitive advantage. Asia Pacific Journal of Innovation and Entrepreneurship, 17(2), 231-249.

Yu, W., Ning, L., & Zhang, L. (2023). Green product innovation and competitive dynamics: The mediating role of knowledge capital. Technological Forecasting and Social Change, 191, 122420.