Influence of Green Innovation on Adaptive Business Capabilities and Sustainable Competitive Advantage in a Dynamic Business Environment

Dr. Shital Nishank Patil[1]
shital.patil@dsims.org.in
Durgadevi Saraf Institute of Management Studies

Jagruti anmol redij[2]
anmol.1001@rediffmail.com
Rohidas Patil Institute of Management Studies

Abstract

Green innovation has emerged as an important strategic approach for organizations seeking to achieve sustainability and maintain competitiveness in a dynamic business environment. The present study examines the influence of green innovation on adaptive business capabilities and sustainable competitive advantage. It focuses on the adoption of environmentally friendly products and services, eco-friendly technologies, sustainable materials, resource efficiency, and waste reduction practices. The study also analyses the relationship between green innovation, organizational adaptability, and long-term competitive advantage. A quantitative and descriptive research design was adopted, using primary data collected from 60 respondents through a structured questionnaire. Convenience and purposive sampling techniques were used, and the collected data were analysed using Microsoft Excel and SPSS through frequency, percentage, descriptive statistics, correlation, regression, and chi-square tests. The findings indicate positive relationships between green innovation, adaptive business capabilities, and sustainable competitive advantage. Green innovation also contributes to improved market differentiation, organizational reputation, and sustainable business performance. However, high implementation costs, limited technical expertise, and uncertainty regarding returns on investment remain significant challenges. The study highlights the importance of integrating green innovation into organizational strategies to strengthen adaptability, improve operational efficiency, and achieve sustainable competitive advantage.

Keywords: Green Innovation, Adaptive Business Capabilities, Sustainable Competitive Advantage, Environmental Sustainability, Green Practices, Dynamic Business Environment.

1. Introduction

In the contemporary business environment, organizations are increasingly confronted with rapid technological advancements, changing consumer preferences, environmental concerns, regulatory pressures, and intense market competition. These developments have necessitated the adoption of innovative business strategies that integrate environmental sustainability with organizational growth and competitiveness. Green innovation has emerged as a significant strategic approach that enables businesses to develop environmentally responsible products, processes, technologies, and management practices while simultaneously creating economic and competitive value. It encompasses the adoption of eco-friendly production methods, energy-efficient technologies, waste reduction practices, sustainable product development, and environmentally conscious organizational strategies.

Green innovation is increasingly recognized as an important contributor to organizational adaptability and long-term business performance. Organizations adopting green innovation can enhance their ability to respond to changing environmental conditions, evolving market demands, and sustainability-related challenges. Through the integration of environmental considerations into business operations, organizations can improve resource efficiency, reduce operational costs, strengthen stakeholder relationships, and develop innovative capabilities. These practices contribute to adaptive business capabilities, enabling firms to modify their strategies, processes, and resources in response to dynamic business conditions.

Furthermore, sustainable competitive advantage has become a critical determinant of organizational success in an increasingly competitive and environmentally conscious marketplace. Businesses that incorporate green innovation into their strategic orientation can differentiate their products and services, enhance brand reputation, improve customer loyalty, and strengthen their market positioning. Environmental sustainability initiatives can also facilitate organizational learning, technological advancement, and the development of unique capabilities that support long-term competitiveness. Consequently, green innovation is not merely an environmental responsibility but also a strategic mechanism for achieving sustainable business growth and competitive differentiation.

Despite the growing recognition of green innovation, its influence on adaptive business capabilities and sustainable competitive advantage requires further empirical investigation, particularly in emerging economies where organizations face diverse operational, technological, and environmental challenges. Understanding the relationship between green innovation, organizational adaptability, and competitive advantage can provide valuable insights into how businesses develop strategic capabilities to sustain performance in dynamic business environments.

Against this backdrop, the present study seeks to examine the influence of green innovation on adaptive business capabilities and sustainable competitive advantage in a dynamic business environment. The study aims to understand how green innovation practices contribute to organizational adaptability and how these adaptive capabilities support the development of sustainable competitive advantage. The findings are expected to provide meaningful insights for business managers, policymakers, and sustainability practitioners in formulating strategies that integrate environmental innovation with organizational effectiveness and long-term competitiveness.

2. Objectives of the Study

1. To examine the influence of green innovation practices on adaptive business capabilities of organizations.
2. To assess the impact of green innovation on sustainable competitive advantage.
3. To analyse the relationship between adaptive business capabilities and sustainable competitive advantage.
4. To evaluate the role of adaptive business capabilities in strengthening the relationship between green innovation and sustainable competitive advantage.

3. Scope of the Study

The present study focuses on examining the influence of green innovation on adaptive business capabilities and sustainable competitive advantage in a dynamic business environment. The study encompasses green innovation practices, including green product innovation, green process innovation, resource efficiency, waste reduction, and environmentally sustainable business practices. It investigates how these practices contribute to organizational adaptability, strategic flexibility, operational efficiency, and the ability of businesses to respond to changing market conditions. Furthermore, the study examines the relationship between adaptive business capabilities and

sustainable competitive advantage in terms of market differentiation, organizational performance, customer satisfaction, and long-term competitiveness.

The study may cover selected organizations operating in sectors such as manufacturing, retail, services, and other industries adopting sustainability-oriented business practices. The geographical scope can be restricted to Mumbai or the Mumbai Metropolitan Region, depending on the research sample. Primary data may be collected from business owners, managers, and executives through structured questionnaires. The findings are expected to provide insights into the strategic significance of green innovation in strengthening adaptive capabilities and achieving sustainable competitive advantage.

4. Review of Literature

1. Hermundsdottir and Aspelund (2021)

In their study Sustainability Innovations and Firm Competitiveness: A Review, the authors reviewed 100 peer-reviewed publications to understand the relationship between sustainability innovation and firm competitiveness. The findings indicated that most studies reported a positive relationship between sustainability innovation and competitiveness. The study identified increased value creation, cost reduction, and improvement in non-financial assets as major competitive benefits. It also highlighted the importance of industry, market, national, and organizational factors in determining innovation outcomes.

2. Khan et al. (2021)

In the study Past, Present, and Future of Green Product Innovation, the authors conducted a systematic literature review of 85 studies on green product innovation. The research identified organizational capabilities, organizational learning, institutional pressures, structural changes, and innovation barriers as important research themes. The findings indicated that successful green product innovation depends on an organization's ability to develop knowledge, adapt internal processes, and respond to changing environmental expectations.

3. Khan et al. (2022)

In their study A Resource-Based View of Green Innovation as a Strategic Firm Resource: Present Status and Future Directions, the researchers examined green innovation through the Resource-Based View of the firm. Their bibliometric analysis of 951 relevant articles highlighted the strategic significance of green innovation as an organizational resource. The study explained that green innovation can contribute to competitive advantage while supporting environmental sustainability. It also identified opportunities for further research into the relationship between green innovation and organizational capabilities

4. Bulo, Halim and Satrya (2026)

In their study Green Innovation as a Force for Competitive Strategy Development and Sustainable Business Performance: A Systematic Literature Review, the authors reviewed 67 peer-reviewed articles published between 2015 and 2025. The study identified resource efficiency, stakeholder alignment, and strategic renewal as important mechanisms through which green innovation contributes to competitive strategy and sustainable business performance. It also highlighted the role of organizational capabilities, leadership practices, and stakeholder relationships in influencing innovation outcomes. The research identified the need for greater integration of theoretical perspectives and further investigation of the dynamic nature of green innovation.

Research Gap

The review of existing literature indicates that several researchers have examined green innovation in relation to environmental performance, organizational resources, green product development, and sustainable competitive advantage. Previous studies have established that green innovation can

improve resource efficiency, organizational reputation, cost effectiveness, and market competitiveness.

5. Research Methodology

The present study adopts a descriptive and quantitative research design to examine the influence of green innovation on adaptive business capabilities and sustainable competitive advantage in a dynamic business environment. The study is based on both primary and secondary data. Primary data were collected through a structured questionnaire-based survey administered to 60 respondents in Mumbai, comprising business owners, entrepreneurs, managers, and employees having knowledge of business operations, innovation practices, and sustainability initiatives. Respondents from Mumbai were selected using convenience and purposive sampling methods. Data were collected through a combination of online and offline survey methods.

Secondary data were gathered from research journals, published articles, books, industry reports, and relevant online sources. The collected data were analysed using appropriate statistical techniques, including frequency and percentage analysis, descriptive statistics, mean and ranking analysis, correlation analysis, and regression analysis, wherever applicable. These techniques help examine the relationship between green innovation, adaptive business capabilities, and sustainable competitive advantage and assess their influence on organizational performance in a dynamic business environment.

Important methodological suggestion: Since Objective 4 examines the mediating role of adaptive business capabilities, mediation analysis using regression-based methods or bootstrapping is recommended. With a sample of 60 respondents from Mumbai, interpret the results cautiously and acknowledge the sample-size limitation.

5.1 Tools for Data Analysis

Data collected from 60 respondents were analysed using Microsoft Excel and SPSS. Frequency and percentage analysis were used to summarise demographic details and responses. Mean and standard deviation were applied to assess green innovation, adaptive business capabilities, and sustainable competitive advantage. Correlation and regression analyses were conducted to examine relationships and the influence among the study variables, while the chi-square test was used to identify associations between selected categorical variables. All hypotheses were tested at a 5% level of significance ($p < 0.05$), and findings were presented through tables and charts.

Secondary data were collected from research journals, books, government publications, industry reports, company sustainability reports, credible websites, and academic databases to establish the theoretical foundation of the study.

5.2 Hypotheses of the Study

- H01: Green innovation practices do not have a significant influence on adaptive business capabilities of organizations.
- H1: Green innovation practices have a significant influence on adaptive business capabilities of organizations.
- H01: Green innovation does not have a significant impact on sustainable competitive advantage.
- H2: Green innovation has a significant impact on sustainable competitive advantage.

- H03: There is no significant relationship between adaptive business capabilities and sustainable competitive advantage.
- H3: There is a significant relationship between adaptive business capabilities and sustainable competitive advantage.
- H04: Adaptive business capabilities do not significantly mediate the relationship between green innovation and sustainable competitive advantage.
- H4: Adaptive business capabilities significantly mediate the relationship between green innovation and sustainable competitive advantage.

6. Data Analysis and Interpretation

Research Title: Influence of Green Innovation on Adaptive Business Capabilities and Sustainable Competitive Advantage in a Dynamic Business Environment

The data collected from 60 respondents in Mumbai were analysed using Microsoft Excel and SPSS. Frequency, percentage, mean, standard deviation, correlation, regression, and chi-square tests were used to analyse the responses. The analysis focuses on green innovation, adaptive business capabilities, sustainable competitive advantage, and challenges associated with implementing green innovation.

Note: The following tables retain the supplied numerical values wherever possible. Since the original questionnaire data and SPSS output have not been provided, these results should be treated as a reframed draft, not independently verified statistical findings.

6.1 Demographic Profile – Type of Organisation

Table 1: Type of Organisation

Type of Organisation	Frequency	Percentage
Manufacturing	15	25.0%
Service	18	30.0%
Retail	10	16.7%
IT/Technology	12	20.0%
Other	5	8.3%
Total	60	100%

Interpretation: The service sector represents the highest proportion of respondents (30%), followed by manufacturing (25%) and IT/technology (20%). Retail and other organisations account for 16.7% and 8.3%, respectively. This indicates representation from diverse business sectors.

6.2 Demographic Profile – Size of Organisation

Table 2: Size of Organisation

Organisation Size	Frequency	Percentage
Micro	8	13.3%
Small	20	33.3%
Medium	18	30.0%
Large	14	23.3%
Total	60	100%

Interpretation: Small organisations constitute the largest group (33.3%), followed by medium-sized organisations (30%). Large and micro organisations account for 23.3% and 13.3%, respectively. The sample therefore provides insights into green innovation practices across organisations of different sizes, particularly MSMEs.

6.3 Green Innovation Practices

Table 3: Green Innovation Practices

Statements	Mean	Std. Deviation
Environmentally friendly products/services are introduced	3.83	0.91
Eco-friendly technologies/processes are adopted	3.72	0.96
Sustainable/recyclable materials and packaging are used	3.65	1.02
Overall Green Innovation Mean	3.73	0.96

Interpretation: The overall mean score of 3.73 indicates a generally positive adoption of green innovation practices. The introduction of environmentally friendly products and services records the highest mean (3.83), suggesting that product and service innovation is a prominent approach towards environmental sustainability.

6.4 Green Innovation and Adaptive Business Capabilities

Table 4: Green Innovation and Adaptive Business Capabilities

Statements	Mean	Std. Deviation
Green innovation helps organisations respond to changing market conditions	3.88	0.87
Green innovation supports operational flexibility during uncertain situations	3.76	0.93
Green innovation improves resource utilisation and reduces environmental risks	3.81	0.89
Overall Adaptive Business Capabilities Mean	3.82	0.90

Interpretation: The overall mean score of 3.82 indicates that respondents generally perceive green innovation as an important contributor to adaptive business capabilities. It supports organisational flexibility, effective resource utilisation, and the ability to respond to changing market and environmental conditions.

6.5 Green Innovation and Sustainable Competitive Advantage

Table 5: Green Innovation and Sustainable Competitive Advantage

Statements	Mean	Std. Deviation
Green innovation differentiates products/services from competitors	3.91	0.86
Green innovation improves reputation and customer preference	3.87	0.89
Green innovation contributes to long-term competitive advantage	3.95	0.83
Overall SCA Mean	3.91	0.86

Interpretation: The overall mean score of 3.91 indicates that respondents recognise green innovation as an important contributor to sustainable competitive advantage. The highest mean (3.95) relates to long-term competitive advantage, indicating the perceived strategic importance of environmental innovation in strengthening market positioning.

6.6 Challenges in Implementing Green Innovation

Table 6: Challenges in Green Innovation

Challenges	Mean	Std. Deviation
High investment and implementation costs	4.02	0.89
Lack of skilled employees/technical expertise	3.76	0.98
Uncertain market demand and ROI	3.81	0.94
Lack of government support/incentives	3.68	1.01
Overall Challenge Mean	3.82	0.96

Interpretation: The overall mean score of 3.82 indicates that organisations face considerable challenges in implementing green innovation. High investment and implementation costs record the highest mean (4.02), followed by uncertainty regarding market demand and return on investment (3.81). Lack of technical expertise and government support also influence the adoption of green innovation.

6.7 Green Innovation and Sustainable Business Performance

Table 7: Green Innovation and Sustainable Business Performance

Statements	Mean	Std. Deviation
Green innovation improves overall business performance	3.84	0.88
Green innovation supports financial and operational sustainability	3.79	0.91
Green innovation improves sustainable business growth	3.86	0.85
Overall Sustainable Business Performance Mean	3.83	0.88

Interpretation: The overall mean score of 3.83 indicates that respondents generally perceive green innovation as contributing positively to sustainable business performance. It suggests that green innovation supports operational efficiency, financial sustainability, and long-term business growth.

7. Hypothesis Testing

The following hypotheses are aligned with the revised research topic and objectives.

7.1 Correlation Analysis

Objective 1, 2 and 3: To examine the relationships among green innovation, adaptive business capabilities, and sustainable competitive advantage.

Table 8: Correlation between Green Innovation and Business Variables

Variables	Green Innovation	Adaptive Business Capabilities	Sustainable Competitive Advantage
Green Innovation	1.000	0.682	0.714
Adaptive Business Capabilities	0.682	1.000	0.641
Sustainable Competitive Advantage	0.714	0.641	1.000

Illustrative Pearson correlation coefficients retained from the supplied analysis.

Interpretation:

1. Green innovation and adaptive business capabilities show a positive correlation of 0.682.
2. Green innovation and sustainable competitive advantage show a positive correlation of 0.714.
3. Adaptive business capabilities and sustainable competitive advantage show a positive correlation of 0.641.

The results indicate positive relationships among all three research variables. Green innovation has a comparatively stronger association with sustainable competitive advantage.

7.2 Regression Analysis – Green Innovation and Adaptive Business Capabilities

H01: Green innovation has no significant influence on adaptive business capabilities.

H1: Green innovation has a significant influence on adaptive business capabilities.

Table 9: Regression Analysis – Green Innovation → Adaptive Business Capabilities

Model	R	R^2	Adjusted R^2	F	Sig.
GI → ABC	0.682	0.465	0.456	50.45	0.000

Interpretation: The R^2 value of 0.465 indicates that approximately 46.5% of the variation in adaptive business capabilities is explained by green innovation. The significance value of 0.000 (p less than 0.001) indicates statistical significance at the 5% level.

Decision: Reject H_{01} and accept H_{11}, subject to verification of the original SPSS output.

7.3 Regression Analysis – Green Innovation and Sustainable Competitive Advantage

H02: Green innovation has no significant impact on sustainable competitive advantage.

H2 Green innovation has a significant impact on sustainable competitive advantage.

Table 10: Regression Analysis – Green Innovation → Sustainable Competitive Advantage

Model	R	R^2	Adjusted R^2	F	Sig.
GI → SCA	0.714	0.510	0.502	60.34	0.000

Interpretation: The R^2 value of 0.510 indicates that approximately 51% of the variation in sustainable competitive advantage is explained by green innovation. The significance value is below 0.05, indicating a statistically significant relationship.

Decision: Reject H_{02} and accept H_{12}, subject to verification of the original SPSS output.

7.4 Relationship between Adaptive Business Capabilities and Sustainable Competitive Advantage

H03: There is no significant relationship between adaptive business capabilities and sustainable competitive advantage.

H3: There is a significant relationship between adaptive business capabilities and sustainable competitive advantage.

The correlation coefficient reported in Table 8 is 0.641, indicating a positive relationship between the two variables.

Interpretation: The positive correlation suggests that organisations with stronger adaptive business capabilities tend to demonstrate higher sustainable competitive advantage. However, the statistical significance of this specific correlation must be verified using its SPSS p-value.

7.5 Mediating Role of Adaptive Business Capabilities

H04: Adaptive business capabilities do not significantly mediate the relationship between green innovation and sustainable competitive advantage.

H4: Adaptive business capabilities significantly mediate the relationship between green innovation and sustainable competitive advantage.

Interpretation: The positive correlations among green innovation, adaptive business capabilities, and sustainable competitive advantage indicate the possibility of a mediating relationship. However, mediation cannot be established through correlation or the two separate regression models alone. A separate mediation analysis using bootstrapping is required to test the indirect effect.

7.6 Additional Analysis – Association between Green Innovation and Sustainable Business Performance

Table 11: Association between Green Innovation Adoption and Sustainable Business Performance

Green Innovation Adoption	Low SBP	Moderate SBP	High SBP	Total
Low	7	4	2	13
Moderate	5	14	8	27
High	2	7	11	20
Total	14	25	21	60

Chi-Square Test Result

Test	Value	df	Sig.
Pearson Chi-Square	15.84	4	0.003

Interpretation: The chi-square significance value of 0.003 is below 0.05, indicating a statistically significant association between green innovation adoption and sustainable business performance. This suggests that organisations with higher green innovation adoption tend to report better sustainable business performance.

Note: This is an additional analysis, not a direct test of Objective 3. The original table measures sustainable business performance, not necessarily sustainable competitive advantage.

7.7 Additional Analysis – Challenges and Green Innovation Adoption

Table 12: Regression Analysis – Implementation Challenges and Green Innovation Adoption

Model	R	R^2	Adjusted R^2	F	Sig.
Challenges → GI Adoption	0.438	0.192	0.178	13.77	0.001

Interpretation: The R^2 value of 0.192 indicates that approximately 19.2% of the variation in green innovation adoption is explained by implementation challenges. The model is statistically significant at the 5% level. However, the direction of the relationship must be confirmed through the regression coefficient (Beta). A negative coefficient would indicate that greater implementation challenges reduce green innovation adoption.

7.8 Summary of Hypothesis Testing

Table 13: Summary of Hypothesis Testing

Hypothesis	Statistical Test	Result	Decision
H01: GI has no significant influence on ABC	Regression	p = 0.000	Reject H_{01}*
H02: GI has no significant impact on SCA	Regression	p = 0.000	Reject H_{02}*
H03: No significant relationship between ABC and SCA	Correlation	r = 0.641	Verify p-value
H04: ABC does not mediate GI and SCA	Mediation analysis	Not available	Further testing required

*Decisions are conditional on the supplied regression statistics being verified against the original dataset and on the revised variable measurements being consistent with the questionnaire.

Findings

1. The service sector represents the highest proportion of respondents (30%), followed by manufacturing (25%).
2. Small and medium-sized organisations constitute 63.3% of the total sample.
3. Green innovation practices have an overall mean score of 3.73, indicating positive adoption among organisations.
4. Environmentally friendly product and service development is the most prominent green innovation practice (mean = 3.83).
5. Adaptive business capabilities record an overall mean score of 3.82, indicating that green innovation supports organisational flexibility and adaptability.
6. Green innovation demonstrates a positive correlation with adaptive business capabilities (r = 0.682).
7. Sustainable competitive advantage records the highest overall mean score of 3.91.
8. Green innovation has a positive correlation with sustainable competitive advantage (r = 0.714).
9. Regression analysis indicates that green innovation explains 51% of the variation in sustainable competitive advantage.
10. Adaptive business capabilities and sustainable competitive advantage show a positive relationship (r = 0.641).
11. High investment and implementation costs are the major challenges in adopting green innovation (mean = 4.02).
12. Lack of technical expertise and uncertainty regarding return on investment are additional barriers to green innovation adoption.

13. Green innovation and sustainable business performance demonstrate a significant association (chi-square = 15.84, p = 0.003).

10. Conclusion

The study concludes that green innovation plays an important role in developing adaptive business capabilities and sustainable competitive advantage in a dynamic business environment. The findings indicate that environmentally friendly products, sustainable technologies, and efficient resource utilisation contribute to organisational adaptability and long-term competitiveness. Green innovation also supports business performance through improved operational efficiency, customer preference, and market differentiation. However, high implementation costs, technological limitations, and uncertainty regarding returns remain significant challenges. Therefore, integrating green innovation into business strategies can support sustainable organisational growth and competitive positioning.

11. Recommendations

1. Organisations should encourage green product and process innovation to improve environmental sustainability.
2. Businesses should invest in energy-efficient technologies and eco-friendly production methods.
3. Management should develop adaptive capabilities to respond effectively to changing market conditions.
4. Organisations should provide technical training and skill development programmes to employees.
5. Small and medium-sized enterprises should explore government incentives and financial assistance for green innovation.
6. Businesses should adopt effective waste management, recycling, and resource conservation practices.
7. Organisations should integrate sustainability objectives into their long-term strategic planning.
8. Regular monitoring of green innovation initiatives should be undertaken to evaluate operational efficiency and competitive benefits.

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