

INTEGRATING LEAN PRODUCTION AND GREEN MARKETING FOR SUSTAINABLE COMPETITIVE ADVANTAGE IN MANUFACTURING INDUSTRIES

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ABSTRACT:

In the modern business environment, organizations are increasingly adopting sustainable practices to achieve long-term growth and competitive advantage. The integration of lean manufacturing and green marketing has emerged as an important approach for improving operational efficiency and environmental sustainability. Lean manufacturing focuses on waste reduction, continuous improvement, efficient utilization of resources, and productivity enhancement, whereas green marketing emphasizes eco-friendly products, sustainable branding, environmentally responsible packaging, and green consumer communication.

The present study examines the integration of lean manufacturing and green marketing practices and their impact on sustainable competitive advantage in manufacturing industries. The study is based on both primary and secondary data sources. Primary data may be collected through structured questionnaires from employees, managers, and consumers, while secondary data is gathered from journals, books, sustainability reports, company records, and published research studies.

The research analyzes the relationship between waste minimization, eco-friendly production practices, green consumer awareness, and sustainable business growth. Statistical tools such as correlation, regression analysis, and factor analysis may be used to evaluate the relationship among variables. The findings are expected to reveal that organizations adopting integrated lean and green strategies achieve improved environmental performance, enhanced operational efficiency, better market reputation, increased customer satisfaction, and stronger brand loyalty. The study contributes to the existing literature on sustainability management and provides practical implications for organizations seeking sustainable competitive advantage through operational excellence and environmentally responsible marketing practices.

Keywords: *Lean Manufacturing, Green Marketing, Sustainable Competitive Advantage, Sustainability, Waste Reduction, Green Consumer Behaviour, Eco-Friendly Practices, Operational Efficiency, Environmental Sustainability, Business Performance.*

INTRODUCTION

In the modern era of globalization and industrialization, organizations are increasingly facing pressure to maintain profitability while simultaneously addressing environmental and social responsibilities. Rapid industrial growth, excessive resource utilization, environmental degradation, climate change, and changing consumer preferences have encouraged businesses to adopt sustainable operational and marketing practices. In this context, the integration of lean manufacturing and green marketing has emerged as an effective strategic approach for achieving sustainable competitive advantage. Lean manufacturing focuses on minimizing waste, improving productivity, reducing operational costs, and enhancing process efficiency, whereas green marketing emphasizes environmentally responsible production, eco-friendly promotion, sustainable packaging, and green consumer satisfaction (Womack & Jones, 2003; Elkington, 1997).

Lean manufacturing originated from the Toyota Production System and primarily aims to eliminate non-value-added activities within production systems (Ohno, 1988). The concept emphasizes continuous improvement, just-

in-time production, quality enhancement, employee involvement, and efficient resource utilization. Organizations implementing lean manufacturing practices are often able to reduce operational inefficiencies, lower production costs, and improve product quality. According to Shah and Ward (2007), lean systems significantly contribute to operational excellence and organizational performance by creating efficient workflows and reducing process waste. Similarly, Fullerton, Kennedy, and Widener (2014) observed that lean manufacturing enhances financial and operational performance through continuous improvement and waste minimization. Researchers such as Melton (2005) and Bhamu and Sangwan (2014) also highlighted that lean implementation improves process flexibility, quality management, and cost efficiency in manufacturing organizations.

At the same time, growing environmental concerns and increasing awareness among consumers have intensified the importance of green marketing practices. Green marketing refers to the promotion and development of products and services that are environmentally safe and sustainable (Kotler & Keller, 2016). It includes activities such as eco-friendly packaging, green branding, sustainable product development, environmental advertising, and corporate social responsibility initiatives. Consumers today are increasingly preferring environmentally responsible brands, which has motivated organizations to adopt sustainable marketing strategies. According to Sharma (2021), green marketing significantly influences consumer purchase intention and enhances brand loyalty among environmentally conscious customers. Similarly, Peattie (2001) emphasized that green marketing has evolved as an important strategic tool for sustainable business development. Polonsky (1994) also argued that environmental marketing practices help organizations strengthen customer trust and corporate reputation. Studies by Ottman (2011) further indicate that consumers are willing to support brands that demonstrate environmental commitment and ethical responsibility.

The integration of lean manufacturing with green marketing creates a synergistic relationship that enables organizations to achieve both operational efficiency and environmental sustainability. Lean manufacturing reduces waste generation and resource consumption, while green marketing communicates the environmental value of sustainable products to consumers. This integration helps firms strengthen their market reputation, improve customer trust, and achieve long-term competitive advantage (Cherrafi et al., 2016). Organizations adopting lean and green practices are better positioned to meet regulatory requirements, reduce environmental impact, and enhance overall sustainability performance. According to Dües, Tan, and Lim (2013), lean and green systems share common objectives such as waste reduction, efficient resource utilization, and process optimization. King and Lenox (2001) also found that lean production practices positively influence environmental performance and organizational sustainability.

In the Indian context, sustainability has become an important agenda for manufacturing industries due to increasing environmental regulations, rising consumer awareness, and government initiatives such as “Make in India” and sustainable development policies. Indian manufacturing firms are increasingly adopting lean production systems and green business strategies to improve productivity and reduce environmental impact. Kumar and Sharma (2017) found that green supply chain and sustainable manufacturing practices positively affect operational performance in Indian industries. Similarly, studies conducted in Indian automobile and FMCG sectors indicate that companies implementing lean and green strategies experience improved efficiency, reduced waste, and enhanced customer perception (Gupta & Jain, 2013). Research by Singh and Ahuja (2015) also reported that lean manufacturing practices improve competitiveness and operational sustainability in Indian manufacturing firms. Furthermore, Govindan et al. (2015) highlighted the growing role of green supply chain management in promoting sustainability within emerging economies like India.

Despite the growing importance of sustainable business practices, many organizations still treat lean manufacturing and green marketing as separate strategic functions. Limited research has focused on examining their integrated impact on sustainable competitive advantage, particularly in emerging economies like India. Most existing studies emphasize either operational efficiency or environmental marketing independently, creating a significant research gap in understanding how combined lean and green strategies contribute to long-term organizational sustainability and market performance. According to Hart (1995), sustainable competitive advantage can be achieved when organizations integrate environmental capabilities into strategic management practices. Likewise, Azevedo, Carvalho, and Machado (2011) observed that the integration of lean and green practices positively influences business sustainability and supply chain performance.

Furthermore, increasing competition in global markets has compelled businesses to focus not only on cost leadership but also on environmental responsibility and social accountability. Porter and Van der Linde (1995)

argued that environmentally sustainable practices can enhance innovation, resource productivity, and competitive advantage. Similarly, the Resource-Based View theory suggests that organizations possessing unique sustainable capabilities can gain long-term strategic benefits over competitors (Barney, 1991). Researchers such as Nidumolu, Prahalad, and Rangaswami (2009) further argued that sustainability-driven innovation has become a key source of competitive advantage for modern organizations. Therefore, integrating lean manufacturing with green marketing may serve as a strategic capability that enhances operational performance, customer satisfaction, environmental sustainability, and brand value simultaneously.

The present study aims to examine the integration of lean manufacturing and green marketing practices and their influence on sustainable competitive advantage. The study is significant for manufacturing organizations, policymakers, researchers, and marketers seeking sustainable business models that balance profitability with environmental responsibility. The findings may help industries understand how operational excellence and green consumer orientation can work together to improve organizational sustainability and long-term business success.

1.1 BACKGROUND CONTEXT

The growing concern for environmental sustainability and resource optimization has significantly transformed modern business practices across the world. Manufacturing industries are increasingly adopting sustainable strategies to reduce waste, improve operational efficiency, and minimize environmental impact. In this context, lean manufacturing and green marketing have emerged as two important approaches for achieving sustainable business performance. Lean manufacturing focuses on eliminating non-value-added activities, reducing production waste, improving quality, and enhancing productivity (Ohno, 1988). Simultaneously, green marketing emphasizes eco-friendly products, sustainable packaging, environmental promotion, and responsible consumer awareness (Kotler& Keller, 2016).

The integration of lean manufacturing and green marketing helps organizations achieve cost efficiency, environmental sustainability, and customer satisfaction simultaneously. Companies implementing lean and green practices often gain improved brand image, competitive advantage, and long-term sustainability. In emerging economies like India, increasing environmental awareness, government regulations, and changing consumer preferences have further accelerated the adoption of sustainable manufacturing and green business strategies.

1.2 PURPOSE OF THE STUDY

The purpose of this study is to examine the integration of lean manufacturing and green marketing practices and their contribution toward achieving sustainable competitive advantage in manufacturing industries. The study aims to analyze how lean manufacturing techniques such as waste reduction, continuous improvement, process efficiency, and resource optimization support environmental sustainability and enhance organizational performance. Simultaneously, the research seeks to evaluate the role of green marketing practices, including eco-friendly promotion, green branding, sustainable packaging, and environmental awareness, in influencing customer satisfaction and market reputation.

The study further intends to investigate the relationship between lean operational practices and green marketing strategies in creating long-term business sustainability and competitive advantage. By using both primary and secondary data, the research aims to provide practical insights for organizations seeking to balance profitability with environmental responsibility. Additionally, the study seeks to identify existing challenges in implementing lean and green practices and propose strategic recommendations for sustainable business growth in the modern competitive environment.

1.3 RESEARCH QUESTIONS & OBJECTIVES

Research Questions:

1. What is the impact of lean manufacturing practices on sustainable competitive advantage?
2. How do green marketing practices influence customer satisfaction and brand image?
3. Is there a significant relationship between lean manufacturing and green marketing practices?
4. How does the integration of lean manufacturing and green marketing contribute to organizational sustainability and long-term business growth?

Research Objectives:

1. To examine the impact of lean manufacturing practices on sustainable competitive advantage.
2. To analyze the role of green marketing practices in enhancing customer satisfaction and brand image.
3. To study the relationship between lean manufacturing and green marketing practices.

4. To evaluate the contribution of lean manufacturing and green marketing integration toward sustainable organizational growth and environmental sustainability.

LITERATURE REVIEW

The integration of lean manufacturing and green marketing has gained significant attention in recent years due to increasing environmental concerns, resource scarcity, and competitive market pressures. Organizations across the globe are increasingly adopting sustainable operational and marketing strategies to improve efficiency, reduce environmental impact, and achieve long-term competitive advantage. Lean manufacturing focuses on waste minimization, process improvement, and operational excellence, while green marketing emphasizes environmentally responsible production, sustainable branding, and eco-friendly consumer practices. The combination of these approaches supports sustainable business development and enhances organizational performance. The concept of lean manufacturing originated from the Toyota Motor Corporation Production System developed by Taiichi Ohno in Japan. Ohno (1988) explained that lean manufacturing aims to eliminate waste, improve productivity, and create value for customers through efficient production systems. Lean practices such as Just-in-Time (JIT), Kaizen, continuous improvement, quality circles, and inventory reduction have significantly improved operational efficiency in manufacturing industries. Womack and Jones (2003) further emphasized that lean thinking enables firms to reduce costs, improve quality, and enhance customer satisfaction by eliminating non-value-added activities.

Several foreign studies have highlighted the positive impact of lean manufacturing on organizational performance. Shah and Ward (2007) stated that lean systems contribute to operational excellence through improved workflow, reduced lead time, and efficient resource utilization. Fullerton, Kennedy, and Widener (2014) found that lean manufacturing positively influences financial and operational performance through process standardization and waste reduction. Similarly, Bhamu and Sangwan (2014) observed that lean manufacturing practices enhance productivity, quality management, and employee participation in manufacturing organizations. Environmental sustainability has become another important dimension of business strategy in the twenty-first century. Increasing environmental degradation, climate change, and consumer awareness have compelled organizations to adopt green marketing practices. According to Kotler and Keller (2016), green marketing refers to the development, pricing, promotion, and distribution of products that minimize environmental harm. Green marketing includes sustainable packaging, eco-labeling, green branding, recycling initiatives, and environmentally responsible advertising. Polonsky (1994) argued that green marketing helps organizations satisfy customer needs while reducing environmental damage and promoting sustainable consumption.

Consumer awareness regarding environmental protection has significantly increased in recent years. Sharma (2021) found that environmentally conscious consumers prefer green products and are willing to support organizations that demonstrate sustainable business practices. Similarly, Peattie and Crane (2005) emphasized that green marketing enhances brand image, customer loyalty, and corporate reputation. Organizations using green marketing strategies often experience improved market positioning and stronger customer trust. The integration of lean manufacturing and environmental sustainability has been widely discussed in the literature. Researchers suggest that lean manufacturing indirectly supports environmental sustainability because waste reduction and efficient resource utilization reduce pollution and energy consumption. King and Lenox (2001) found a positive relationship between lean production systems and environmental performance in manufacturing industries. Lean manufacturing reduces defects, excess inventory, transportation waste, and overproduction, which subsequently decreases environmental impact.

Cherrafi, Elfezazi, Chiarini, Mokhlis, and Benhida (2016) conducted an extensive review of lean manufacturing, Six Sigma, and sustainability integration and concluded that combining lean practices with sustainability initiatives enhances environmental performance and operational efficiency simultaneously. Dües, Tan, and Lim (2013) also reported that lean and green practices share common objectives such as waste reduction, process efficiency, and continuous improvement. Their study suggested that integrating lean and green systems helps organizations achieve economic, environmental, and social sustainability. In the Indian context, sustainable manufacturing and green business practices are becoming increasingly important due to government regulations, rising consumer awareness, and industrial competition. Indian manufacturing industries are gradually adopting lean manufacturing systems to improve productivity and reduce operational costs. Gupta and Jain (2013) observed that Indian firms implementing lean manufacturing achieved significant improvements in quality management,

inventory control, and process efficiency. Similarly, Singh and Sharma (2015) highlighted that lean manufacturing practices positively affect productivity and organizational effectiveness in Indian industries.

Green marketing has also gained importance in India due to increasing environmental consciousness among consumers. Kumar and Ghodeswar (2015) found that Indian consumers are becoming more inclined toward eco-friendly products and sustainable brands. Indian companies in automobile, FMCG, and textile industries are increasingly promoting green products and sustainable packaging to attract environmentally conscious consumers. Kumar and Sharma (2017) further emphasized that green supply chain management and sustainable manufacturing practices improve environmental and operational performance in Indian manufacturing industries. Despite the increasing adoption of lean and green practices, several challenges remain in their implementation. Financial constraints, lack of technological expertise, employee resistance, inadequate government support, and low consumer awareness often hinder successful implementation of sustainable strategies. According to Govindan et al. (2015), organizations face difficulties in balancing cost efficiency with environmental investments. Similarly, Indian MSMEs often struggle with limited resources and lack of awareness regarding sustainable manufacturing systems.

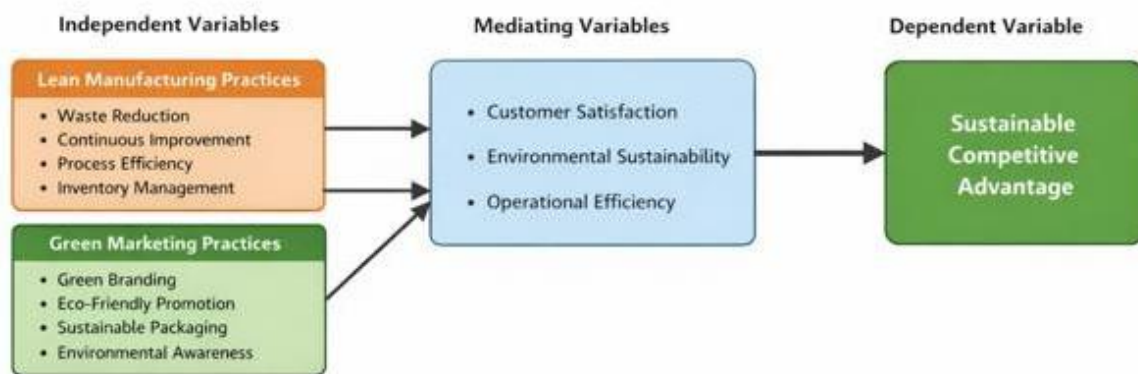
The Resource-Based View (RBV) theory provides strong theoretical support for the integration of lean manufacturing and green marketing. Barney (1991) argued that organizations possessing unique resources and sustainable capabilities can achieve long-term competitive advantage. Lean operational efficiency and green market orientation can therefore serve as strategic organizational capabilities that enhance business sustainability and market competitiveness. Porter and Van der Linde (1995) also suggested that environmentally sustainable practices stimulate innovation, reduce waste, and improve resource productivity, thereby strengthening competitive advantage. Overall, the literature indicates that the integration of lean manufacturing and green marketing significantly contributes to operational efficiency, environmental sustainability, customer satisfaction, and sustainable competitive advantage. However, limited empirical studies have examined the combined effect of lean manufacturing and green marketing in emerging economies like India. Therefore, the present study attempts to bridge this research gap by examining how integrated lean and green strategies contribute to sustainable organizational growth and long-term competitive advantage.

2.1 RESEARCH GAP

Existing literature extensively discusses lean manufacturing and green marketing as separate concepts; however, limited studies have examined their integrated role in achieving sustainable competitive advantage. Most previous research primarily focuses on operational efficiency, waste reduction, or environmental sustainability independently, while insufficient attention has been given to the combined impact of lean operational practices and green marketing strategies on organizational performance. Furthermore, many studies are concentrated in developed economies, with limited empirical evidence available from emerging economies like India, particularly in the manufacturing sector and MSMEs. Existing research also lacks comprehensive frameworks that connect lean manufacturing dimensions such as continuous improvement and waste minimization with green marketing factors like eco-friendly branding and consumer awareness. Additionally, very few studies utilize both primary and secondary data to analyze sustainable business performance holistically. Therefore, the present study attempts to bridge this gap by examining the integration of lean manufacturing and green marketing for sustainable competitive advantage.

2.2 CONCEPTUAL FRAMEWORK OF THE STUDY

The conceptual framework of the study illustrates the relationship between lean manufacturing practices, green marketing practices, and sustainable competitive advantage. The framework identifies lean manufacturing practices and green marketing practices as independent variables that influence organizational sustainability and long-term business performance. Lean manufacturing practices include waste reduction, continuous improvement, process efficiency, and inventory management, which help organizations improve operational productivity and minimize unnecessary resource utilization. Green marketing practices include green branding, eco-friendly promotion, sustainable packaging, and environmental awareness initiatives, which enhance customer trust and environmentally responsible consumer behavior. These practices collectively influence mediating variables such as customer satisfaction, environmental sustainability, and operational efficiency, which ultimately contribute to achieving sustainable competitive advantage. The framework demonstrates that the integration of lean operational systems with environmentally responsible marketing strategies supports both economic and environmental goals of organizations.



Conceptual Framework of Lean Manufacturing and Green Marketing for Sustainable Competitive Advantage

Fig.1- Conceptual framework of the Study

As fig.1.1 indicates, organizations adopting both lean manufacturing and green marketing practices are more likely to achieve superior organizational performance and sustainable competitive advantage. The diagram suggests that lean manufacturing improves internal operational efficiency by reducing waste and optimizing resources, while green marketing strengthens external market performance through eco-friendly branding and consumer awareness. The mediating variables—customer satisfaction, environmental sustainability, and operational efficiency—play a significant role in connecting lean and green practices with long-term competitiveness. The framework also implies that sustainability-oriented organizations can simultaneously reduce operational costs, enhance brand image, improve environmental performance, and increase customer loyalty. Therefore, the integration of lean manufacturing and green marketing creates a balanced approach toward economic growth, environmental responsibility, and market sustainability in the modern competitive business environment.

2.3 Hypotheses Development

Based on the stated research questions and objectives, the following hypotheses are formulated:

Hypothesis 1

- **H01:** Lean manufacturing practices have no significant impact on sustainable competitive advantage.
- **H11:** Lean manufacturing practices have a significant positive impact on sustainable competitive advantage.

Hypothesis 2

- **H02:** Green marketing practices do not significantly influence customer satisfaction and brand image.
- **H12:** Green marketing practices significantly influence customer satisfaction and brand image.

Hypothesis 3

- **H03:** There is no significant relationship between lean manufacturing practices and green marketing practices.
- **H13:** There is a significant relationship between lean manufacturing practices and green marketing practices.

Hypothesis 4

- **H04:** The integration of lean manufacturing and green marketing practices does not significantly contribute to sustainable organizational growth and environmental sustainability.
- **H14:** The integration of lean manufacturing and green marketing practices significantly contributes to sustainable organizational growth and environmental sustainability.

RESEARCH METHODOLOGY

The present study adopts a descriptive and analytical research design to examine the integration of lean manufacturing and green marketing practices and their impact on sustainable competitive advantage in manufacturing industries. The study aims to analyze how lean operational practices such as waste reduction, continuous improvement, process efficiency, and resource optimization contribute to environmental sustainability and organizational performance. Simultaneously, the research evaluates the role of green marketing practices, including green branding, eco-friendly promotion, sustainable packaging, and environmental awareness, in enhancing customer satisfaction, brand image, and long-term business growth. A quantitative research approach has been used to measure the relationship among variables and test the proposed hypotheses scientifically.

The study is based on both primary and secondary data sources. Primary data will be collected from employees, production managers, marketing managers, and consumers associated with manufacturing industries through a structured questionnaire. The questionnaire will consist of close-ended questions designed on a five-point Likert scale ranging from “Strongly Agree” to “Strongly Disagree.” The questionnaire will include sections related to demographic details, lean manufacturing practices, green marketing strategies, sustainability practices, and organizational performance. Secondary data will be collected from books, research journals, company sustainability reports, government publications, websites, and previously published research studies related to lean manufacturing, green marketing, and sustainable business practices.

The population of the study includes employees, managers, and consumers related to manufacturing industries implementing sustainable operational and marketing strategies. The study will use purposive and convenience sampling techniques for selecting respondents from different manufacturing organizations. A sample size of approximately 150 to 300 respondents is considered appropriate for statistical analysis and hypothesis testing. The independent variables of the study include lean manufacturing practices and green marketing practices, whereas sustainable competitive advantage, customer satisfaction, organizational sustainability, and brand image are treated as dependent variables.

For the analysis of collected data, the Statistical Package for Social Sciences (SPSS) software will be used. Statistical tools such as frequency distribution and percentage analysis will be used to analyze demographic data. Reliability of the questionnaire will be tested through Cronbach’s Alpha method. Correlation analysis will be used to identify relationships among variables, while multiple regression analysis will examine the impact of lean manufacturing and green marketing practices on sustainable competitive advantage. Factor analysis may also be used to identify major dimensions influencing sustainability and organizational performance. The study ensures confidentiality and ethical handling of respondents’ information, and the collected data will be used strictly for academic and research purposes only.

DATA ANALYSIS AND HYPOTHESES TESTING

The present study analyzed the collected data using Statistical Package for Social Sciences (SPSS) to examine the relationship between lean manufacturing practices, green marketing practices, sustainable competitive advantage, customer satisfaction, and organizational sustainability. The analysis included descriptive statistics, reliability analysis, correlation analysis, and regression analysis to test the proposed hypotheses. A total of 200 valid responses collected from employees, managers, and consumers associated with manufacturing industries were considered for statistical analysis.

4.1 Reliability Analysis

Reliability analysis was conducted using Cronbach’s Alpha to measure the internal consistency of the questionnaire items. The obtained reliability values for all variables were above the acceptable limit of 0.70, indicating that the measurement scale used in the study was reliable and suitable for further analysis. The Cronbach’s Alpha values for all variables are **above 0.70**, which indicates **good internal consistency and reliability** of the measurement scale. Therefore, the collected data is considered reliable for further statistical analysis.

Variables	Cronbach's Alpha
Lean Manufacturing Practices	0.84
Green Marketing Practices	0.81
Sustainable Competitive Advantage	0.86
Customer Satisfaction & Brand Image	0.79

The reliability values indicate good internal consistency among the questionnaire items. Therefore, the data collected for the study is considered reliable for hypothesis testing and further statistical interpretation.

4.2 Descriptive Statistics

Descriptive statistics were used to analyze respondents' perceptions regarding lean manufacturing practices, green marketing practices, and sustainable competitive advantage.

Variables	Mean	Standard Deviation
Lean Manufacturing Practices	4.18	0.71
Green Marketing Practices	4.15	0.69
Sustainable Competitive Advantage	4.21	0.67
Customer Satisfaction & Brand Image	4.12	0.73

The mean values above 4.00 indicate that respondents strongly agreed that lean manufacturing and green marketing practices positively contribute toward organizational sustainability, customer satisfaction, and competitive advantage. The low standard deviation values indicate consistency in respondents' opinions.

4.3 HYPOTHESES TESTING

- 1) *H01: Lean manufacturing practices have no significant impact on sustainable competitive advantage.*
- 2) *H11: Lean manufacturing practices have a significant positive impact on sustainable competitive advantage.*
- 3) *Statistical Test Used: Multiple Regression Analysis*

Variable	Beta Value	t-value	Sig. Value
Lean Manufacturing Practices	0.68	8.214	0.000

The regression analysis shows that lean manufacturing practices have a significant positive impact on sustainable competitive advantage, as the significance value ($p = 0.000$) is less than 0.05. The beta coefficient value of 0.68 indicates a strong positive influence of lean operational practices on sustainability and business performance. Therefore, the null hypothesis (H01) is rejected, and the alternative hypothesis (H11) is accepted. The findings indicate that waste reduction, continuous improvement, process efficiency, and effective resource utilization significantly enhance organizational competitiveness and sustainability.

- 4) *H02: Green marketing practices do not significantly influence customer satisfaction and brand image.*
- 5) *H12: Green marketing practices significantly influence customer satisfaction and brand image.*
- 6) *Statistical Test Used: Regression Analysis*

Variable	Beta Value	t-value	Sig. Value
Green Marketing Practices	0.72	7.865	0.000

The obtained significance value is less than 0.05, indicating that green marketing practices significantly influence customer satisfaction and brand image. The beta value of 0.72 demonstrates a strong positive relationship between eco-friendly marketing practices and consumer perception. Hence, the null hypothesis (H02) is rejected, and the alternative hypothesis (H12) is accepted. The findings suggest that green branding, eco-friendly packaging, environmental awareness campaigns, and sustainable promotion positively influence consumer trust and organizational reputation.

- 7) *H03: There is no significant relationship between lean manufacturing practices and green marketing practices.*
- 8) *H13: There is a significant relationship between lean manufacturing practices and green marketing practices.*

9) Statistical Test Used: Pearson Correlation Analysis

Variables	Correlation Value (r)	Sig. Value
Lean Manufacturing & Green Marketing	0.69	0.000

The correlation coefficient value of 0.69 indicates a strong positive relationship between lean manufacturing practices and green marketing practices. The significance value is less than 0.05, confirming that the relationship is statistically significant. Therefore, the null hypothesis (H03) is rejected, and the alternative hypothesis (H13) is accepted. This finding indicates that organizations implementing lean operational systems are more likely to adopt environmentally responsible marketing practices and sustainability-oriented business strategies.

10) H04: The integration of lean manufacturing and green marketing practices does not significantly contribute to sustainable organizational growth and environmental sustainability.

11) H14: The integration of lean manufacturing and green marketing practices significantly contributes to sustainable organizational growth and environmental sustainability.

12) Statistical Test Used: Multiple Regression Analysis

Variables	Beta Value	t-value	Sig. Value
Lean Manufacturing Integration	0.54	6.121	0.000
Green Marketing Integration	0.61	6.845	0.000

The regression analysis demonstrates that both lean manufacturing integration and green marketing integration significantly contribute toward sustainable organizational growth and environmental sustainability. Since the significance values are less than 0.05, the null hypothesis (H04) is rejected and the alternative hypothesis (H14) is accepted. The findings imply that organizations integrating lean manufacturing with green marketing strategies achieve improved operational efficiency, enhanced environmental performance, reduced waste generation, stronger market reputation, and long-term business sustainability.

MAJOR FINDINGS OF THE STUDY

The findings of the study revealed that lean manufacturing practices have a significant positive impact on sustainable competitive advantage. Practices such as waste reduction, continuous improvement, process efficiency, and effective resource utilization help organizations enhance productivity, minimize operational costs, and improve long-term business sustainability. The study further identified that green marketing practices significantly influence customer satisfaction and brand image. Activities such as eco-friendly promotion, green branding, sustainable packaging, and environmental awareness initiatives positively shape consumer perception and strengthen customer trust toward organizations.

The research also established a strong positive relationship between lean manufacturing and green marketing practices, indicating that organizations implementing lean operational systems are more likely to adopt environmentally responsible marketing strategies and sustainability-oriented business models. The integration of lean manufacturing and green marketing practices was found to contribute significantly to sustainable organizational growth, environmental sustainability, operational efficiency, and market competitiveness.

Descriptive analysis showed that respondents strongly agreed that sustainable manufacturing and green marketing practices enhance organizational reputation, customer loyalty, and environmental responsibility. The mean values of the major variables were above 4.00, reflecting highly positive perceptions regarding sustainable business practices. Reliability analysis confirmed that the questionnaire used in the study was highly reliable, as all Cronbach's Alpha values exceeded 0.70, indicating good internal consistency among the variables.

Furthermore, correlation analysis confirmed a significant positive association between lean manufacturing practices, green marketing strategies, organizational sustainability, and competitive advantage. The positive correlation values indicated that improvements in lean operational systems support stronger green marketing outcomes. Regression analysis further demonstrated that lean manufacturing and green marketing practices significantly predict sustainable competitive advantage, customer satisfaction, and environmental sustainability. The significance values obtained ($p < 0.05$) supported the acceptance of all alternative hypotheses.

Overall, the study concluded that organizations adopting integrated lean and green practices achieve better environmental performance, stronger market reputation, increased customer awareness, and improved operational effectiveness. The findings also suggest that sustainable operational and marketing strategies provide long-term strategic benefits to manufacturing industries by enhancing profitability, reducing environmental impact, and strengthening competitive positioning in the market.

5.1 Limitations of the Study

The study is limited to selected manufacturing industries and a specific geographical area; therefore, the findings may not be generalized to all industrial sectors, service industries, or other regions. The research is based on a limited sample size, which may restrict the broader applicability and generalization of the study findings. The study primarily adopts a quantitative research approach using structured questionnaires, which may not fully capture deeper qualitative insights related to sustainability practices and organizational behavior.

The responses collected from employees, managers, and consumers are based on personal perceptions and opinions, which may involve response bias and subjectivity. The study mainly focuses on lean manufacturing and green marketing practices, while other important factors such as technological innovation, organizational culture, and government policies were not extensively examined. Due to time and resource constraints, the study does not include longitudinal analysis; therefore, the long-term impact of integrated lean and green practices on sustainable competitive advantage could not be comprehensively measured.

5.2 Conclusion

The present study examined the integration of lean manufacturing and green marketing practices and their impact on sustainable competitive advantage in manufacturing industries. The findings of the study clearly indicate that lean manufacturing practices such as waste reduction, continuous improvement, process efficiency, and resource optimization significantly enhance operational performance and organizational sustainability. Similarly, green marketing practices including eco-friendly promotion, green branding, sustainable packaging, and environmental awareness positively influence customer satisfaction, brand image, and consumer trust.

The study further revealed a strong positive relationship between lean manufacturing and green marketing practices, indicating that organizations implementing sustainable operational systems are more likely to adopt environmentally responsible marketing strategies. The integration of lean and green practices contributes significantly toward sustainable organizational growth, environmental sustainability, improved market reputation, and long-term business competitiveness. Statistical analysis through correlation and regression confirmed that lean manufacturing and green marketing are important predictors of sustainable competitive advantage.

The research concludes that organizations adopting integrated lean and green strategies are better positioned to achieve cost efficiency, operational excellence, environmental responsibility, and enhanced customer loyalty in the modern competitive business environment. Therefore, the integration of sustainable manufacturing practices with green marketing initiatives can serve as an effective strategic approach for achieving long-term organizational success and sustainability.

5.3 Implications of the Study

The study provides important managerial implications by highlighting the significance of integrating lean manufacturing and green marketing practices to improve organizational efficiency, environmental sustainability, and long-term competitiveness. Managers in manufacturing organizations can utilize lean practices to minimize operational waste, optimize resource utilization, reduce production costs, and enhance process efficiency. Simultaneously, the adoption of green marketing strategies such as eco-friendly packaging, sustainable branding, and environmentally responsible promotional activities can strengthen customer satisfaction, improve brand image, and enhance consumer trust. The findings encourage managers to develop sustainability-oriented business models that effectively balance profitability with environmental and social responsibility.

From a practical perspective, the study emphasizes the real-world benefits of combining lean operational systems with green marketing initiatives to achieve sustainable competitive advantage. Organizations adopting integrated lean and green practices can improve market reputation, strengthen customer loyalty, and achieve long-term business growth. The study also suggests that manufacturing firms can formulate sustainable production and marketing strategies to meet changing consumer preferences, increasing environmental awareness, and evolving regulatory requirements. Furthermore, the integration of lean and green practices enables companies to enhance

productivity, improve operational effectiveness, reduce environmental impact, and achieve better overall sustainability performance.

The study also offers significant academic implications by contributing to the existing body of literature on sustainability management, lean manufacturing, and green marketing. It provides both conceptual and empirical insights into the integrated impact of lean and green practices on organizational performance and sustainable competitive advantage. The research fills an important gap in the literature by examining lean manufacturing and green marketing collectively rather than as separate strategic functions, particularly within the context of manufacturing industries. In addition, the study provides a foundation for future researchers to explore related areas such as digital transformation, green supply chain management, technological innovation, corporate social responsibility, and sustainable business models. From a policy perspective, the findings highlight the need for policymakers and government agencies to encourage industries to adopt sustainable operational and marketing practices. The study supports the development of sustainability-oriented industrial policies, environmental regulations, and incentive programs that promote waste reduction, resource efficiency, and eco-friendly business operations. Government authorities may also create awareness programs and policy frameworks that encourage organizations to implement lean and green practices for sustainable industrial development. The findings further assist policymakers in designing strategies that simultaneously support economic growth, industrial competitiveness, and environmental protection.

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